

The SDSS SN Survey



Saurabh Jha
KIPAC/SLAC

for the SDSS-II SN collaboration



SDSS-II SN Collaboration

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G. Saurage, S. Snedden, S. Watters
B. Bassett, K. van der Heyden
A. Becker, C. Hogan
R. Bender, U. Hopp
C. Choi, M. Im
D. Cinabro
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W. Kollatschny
H. Lampeitl, A. Riess
R. Nichol, M. Smith
M. Richmond
M. Sako
D. Schneider
C. Wheeler

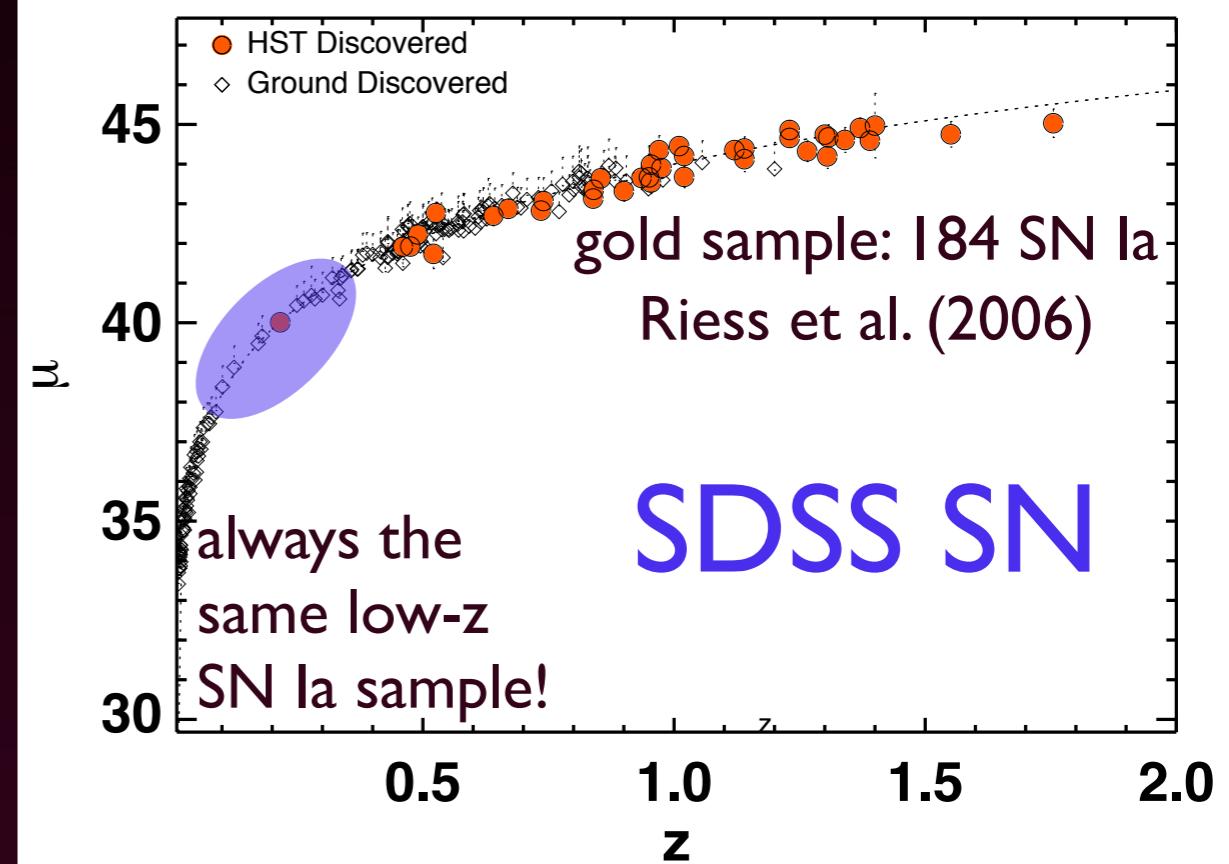
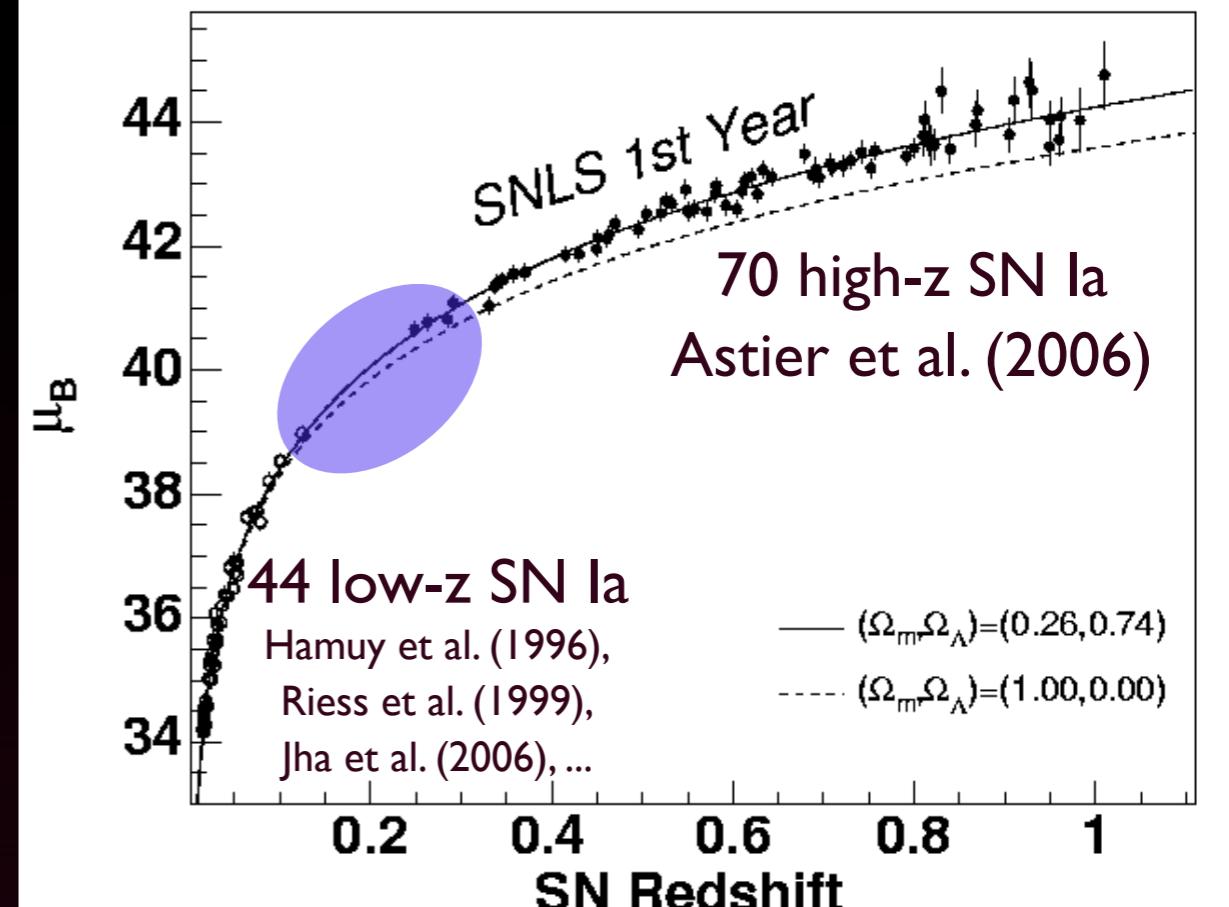
J. Frieman



with help from: J. Eastman, L. Watson, R. Assef,
K. Schlesinger, A. Croots, M. Stritzinger,
J. Sollerman, A. Goobar, G. Leloudas, R. J. Foley,
A. V. Filippenko, A. Aragon-Salamanca,
M. Bremer, M. Turatto, P. Ruiz-Lapuente,
F. Castander, A. Romer, C. Collins, J. Lucey,
A. Edge, Y. Ihara

SN Ia Hubble Diagram

- main goal of the SDSS SN survey:
fill in the SN Ia Hubble diagram at
intermediate redshift, $0.1 \lesssim z \lesssim 0.3$
 - connect low-z with high-z
 - confirm concordance cosmology
(or find some surprises!)
 - challenges
 - peak magnitudes $m \simeq 20-22$
 - need to search hundreds of deg^2
- SDSS 2.5m telescope + imager



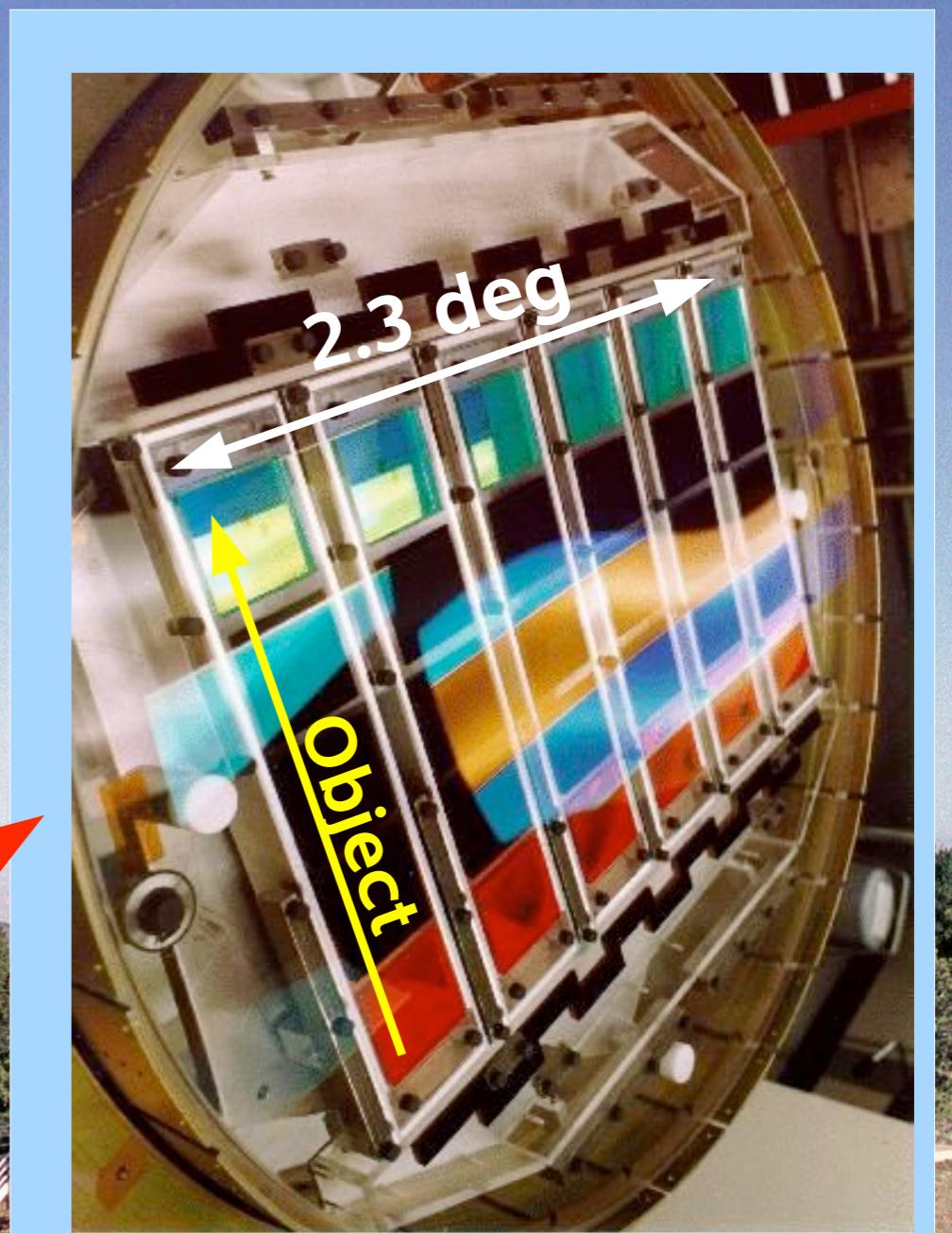
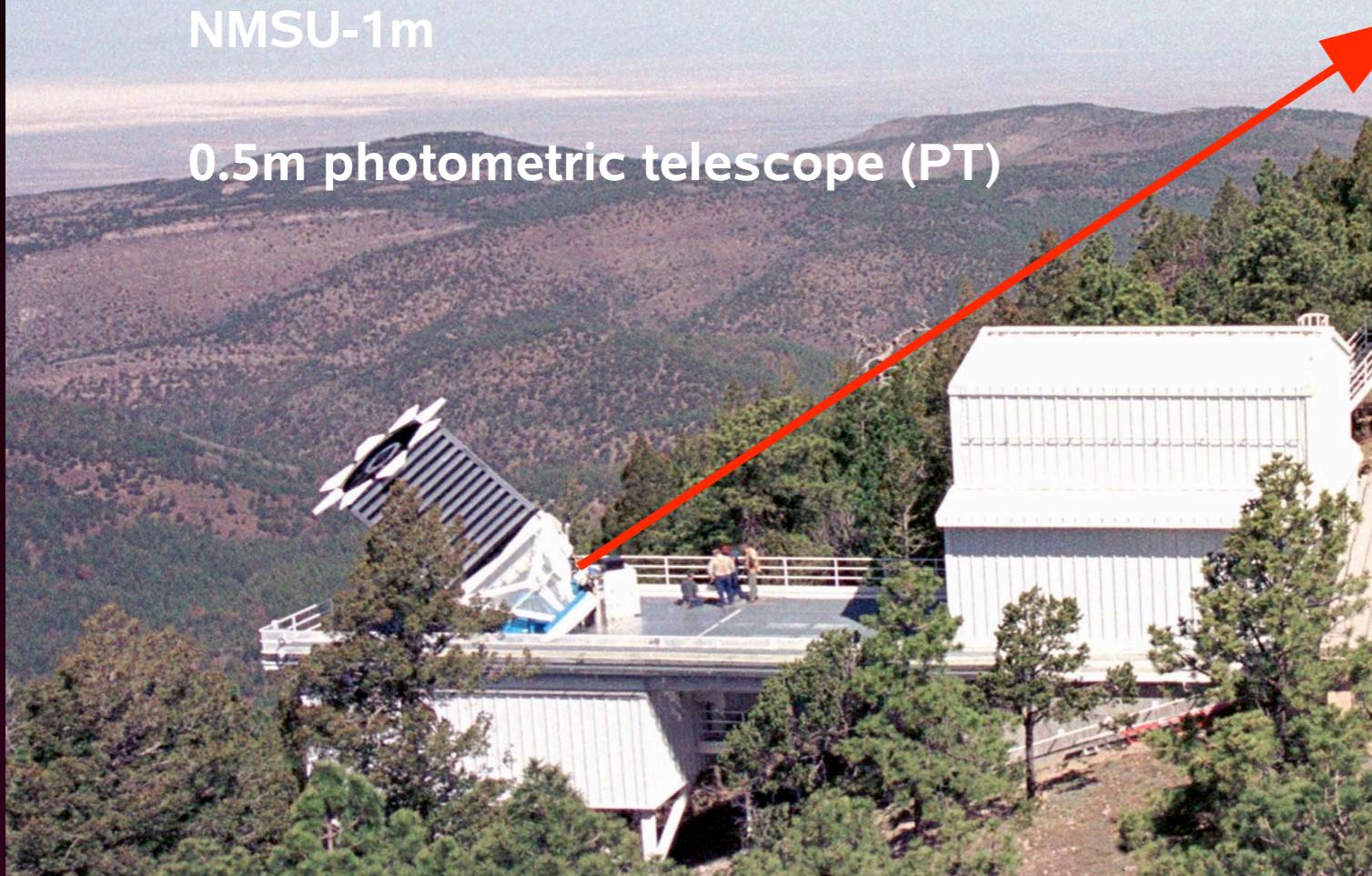
Apache Point Observatory Southern New Mexico

2.5 m f/5 modified Ritchey-Chretien
- camera (u,g,r,i,z)
- spectrograph (640 fibers)

ARC-3.5m

NMSU-1m

0.5m photometric telescope (PT)

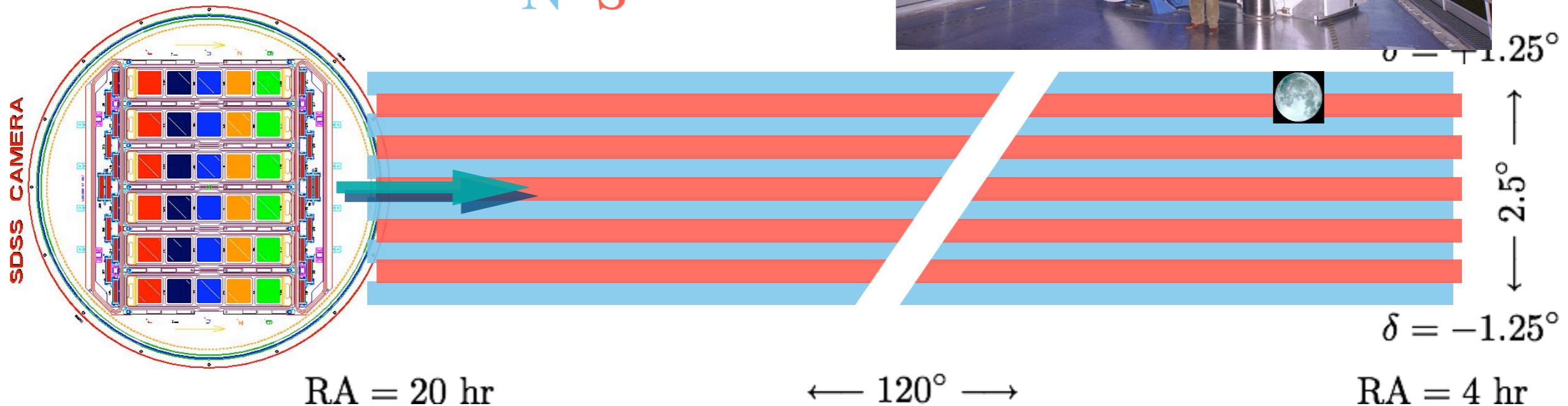


u	g	r	i	z
22.0	22.2	22.2	21.3	20.5
(56s, 95%, stars)				

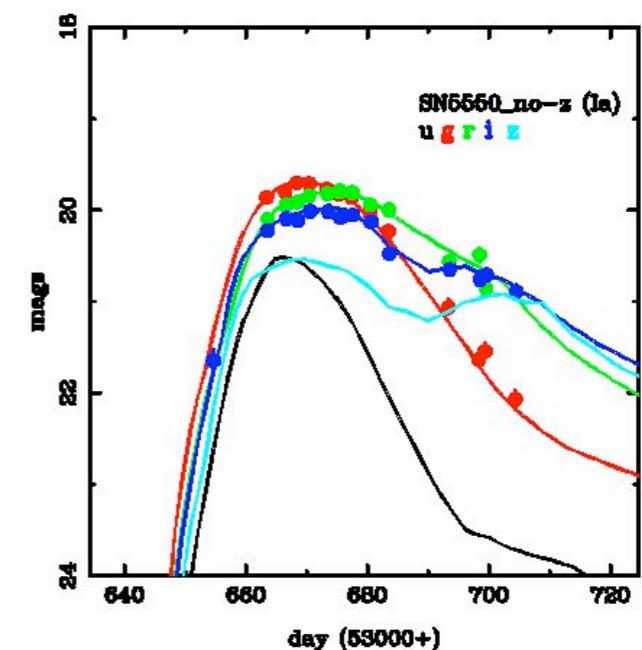
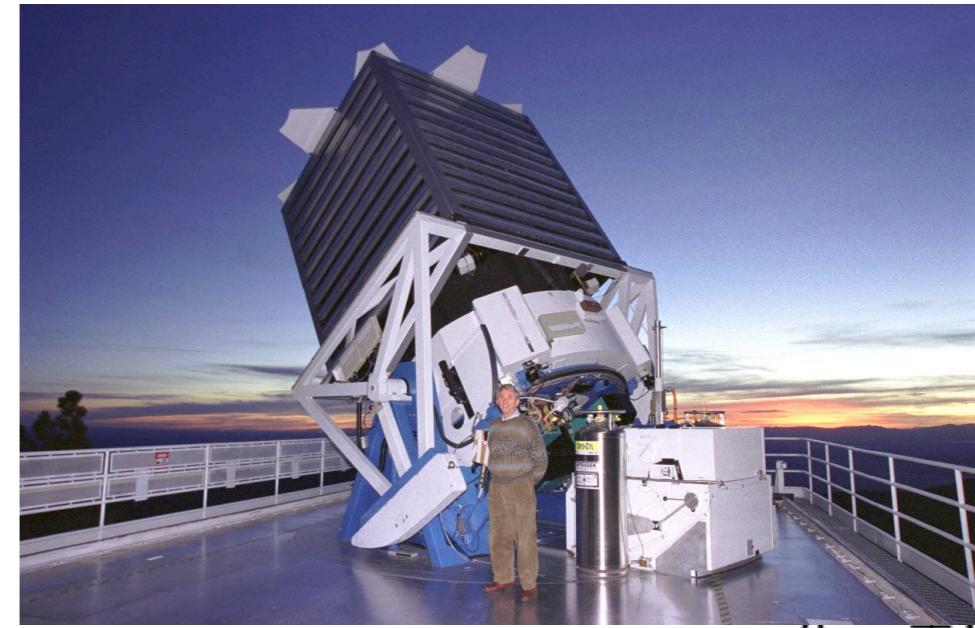
SNe Survey

September 1 – November 30 of 2005-2007
Scan 280 sq. degrees every 2 days
multi-color light curves
spectroscopic followup

N S



- Type Ia supernovae (SNe)
 - spectroscopically confirm and obtain “well-measured” light curves of ~ 200 SN Ia from $z = 0.05 \sim 0.4$ in u,g,r,i and z
 - understand and minimize systematics of SN Ia
- Other SN-Types Ib/c, Type II
- Rates and Environment

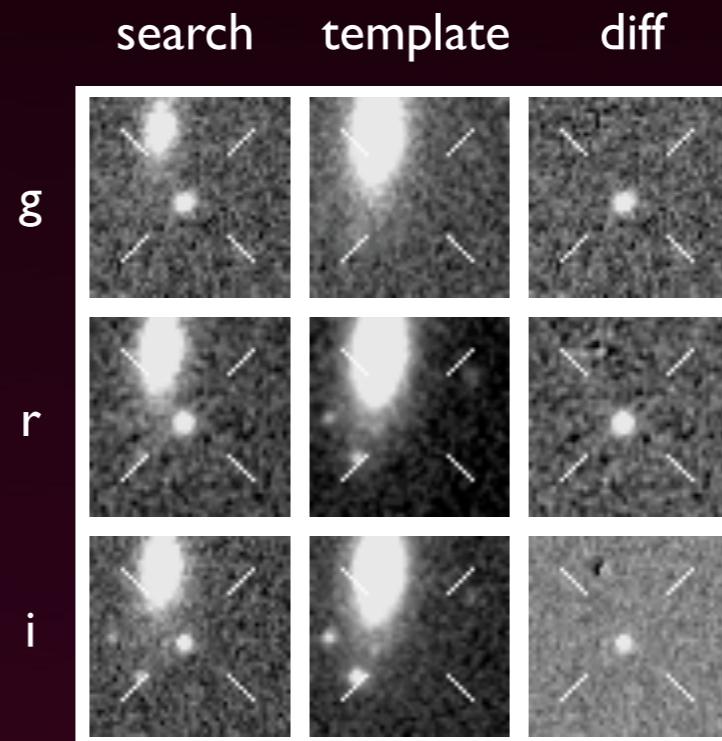
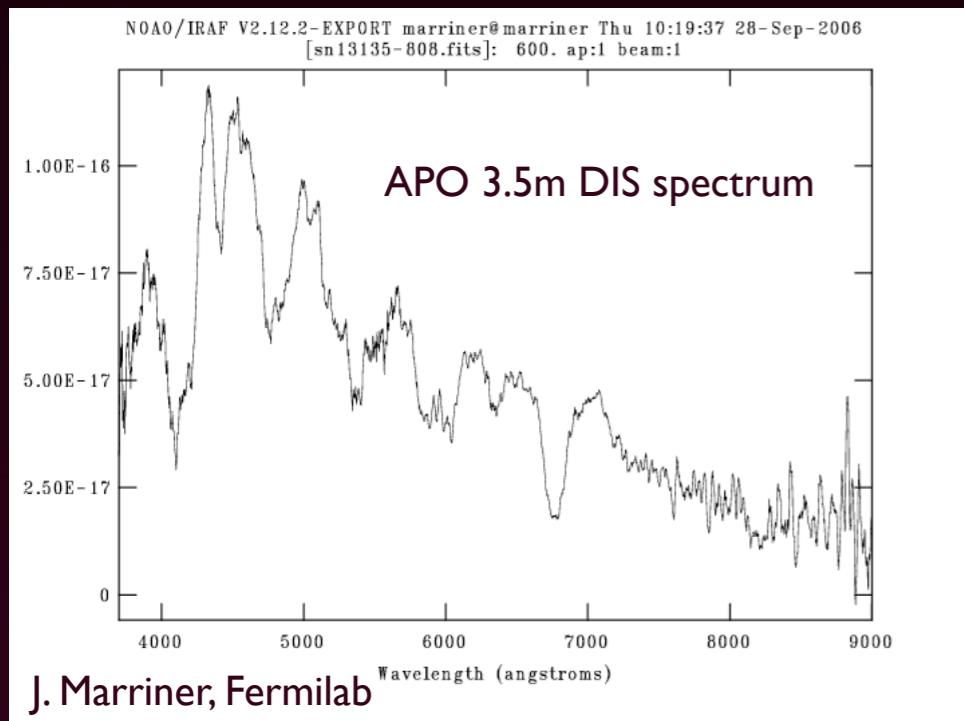
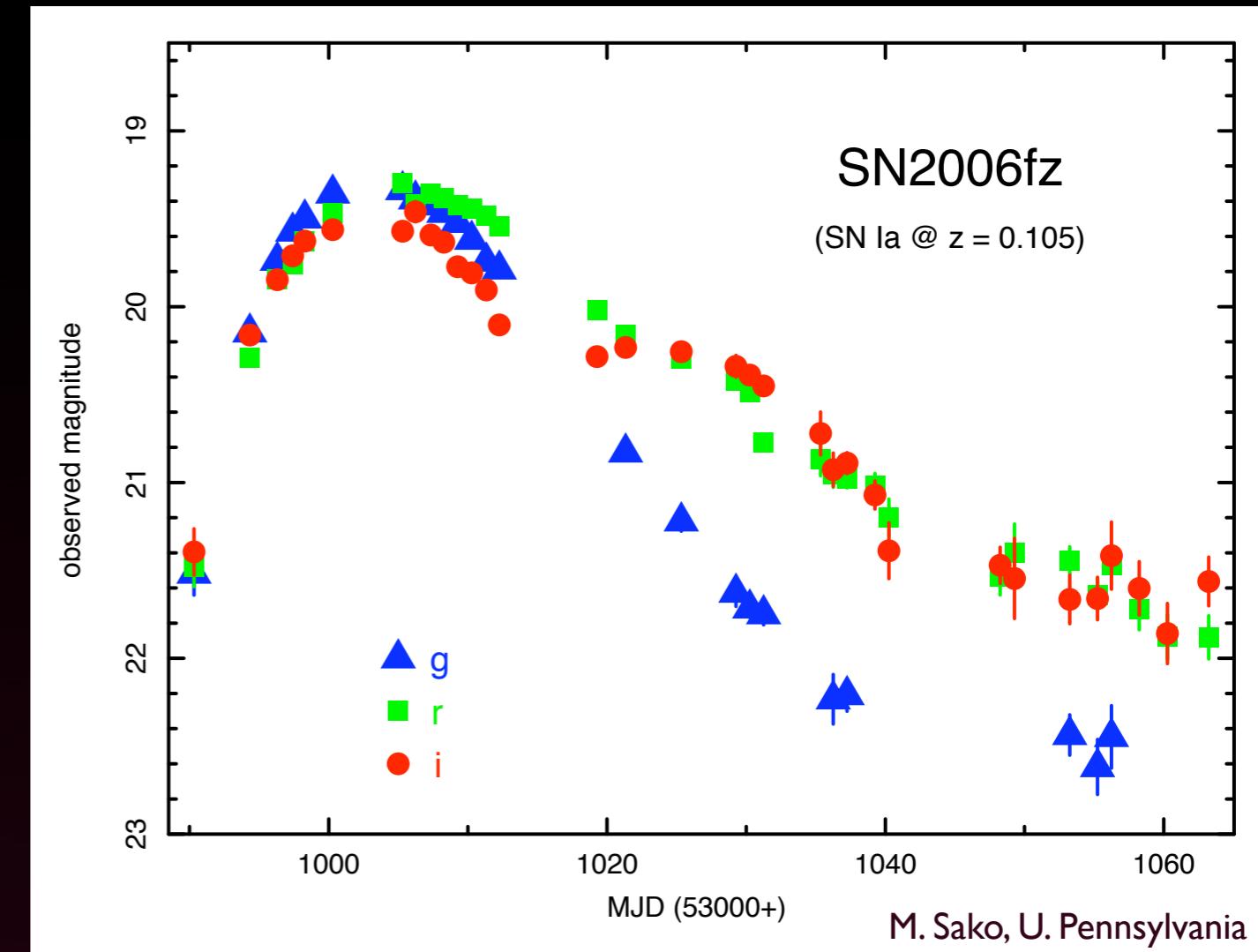


Details for Candidate SN13135

Initial RA (deg)	4.172303
Initial Dec (deg)	-0.424537
Averaged RA (deg)	4.172286
Averaged Dec (deg)	-0.424540
Averaged RA (hh:mm:ss)	0:16:41.35
Averaged Dec (dd:mm:ss)	-0:25:28.3
Redshift	0.1050
IUAC Name	2006fz
Observability	0.000
Time weight	0.000
Crowding weight	-1.000
Dust weight	-1.000
Entry date/time	2006-09-16 18:00:38

Fits

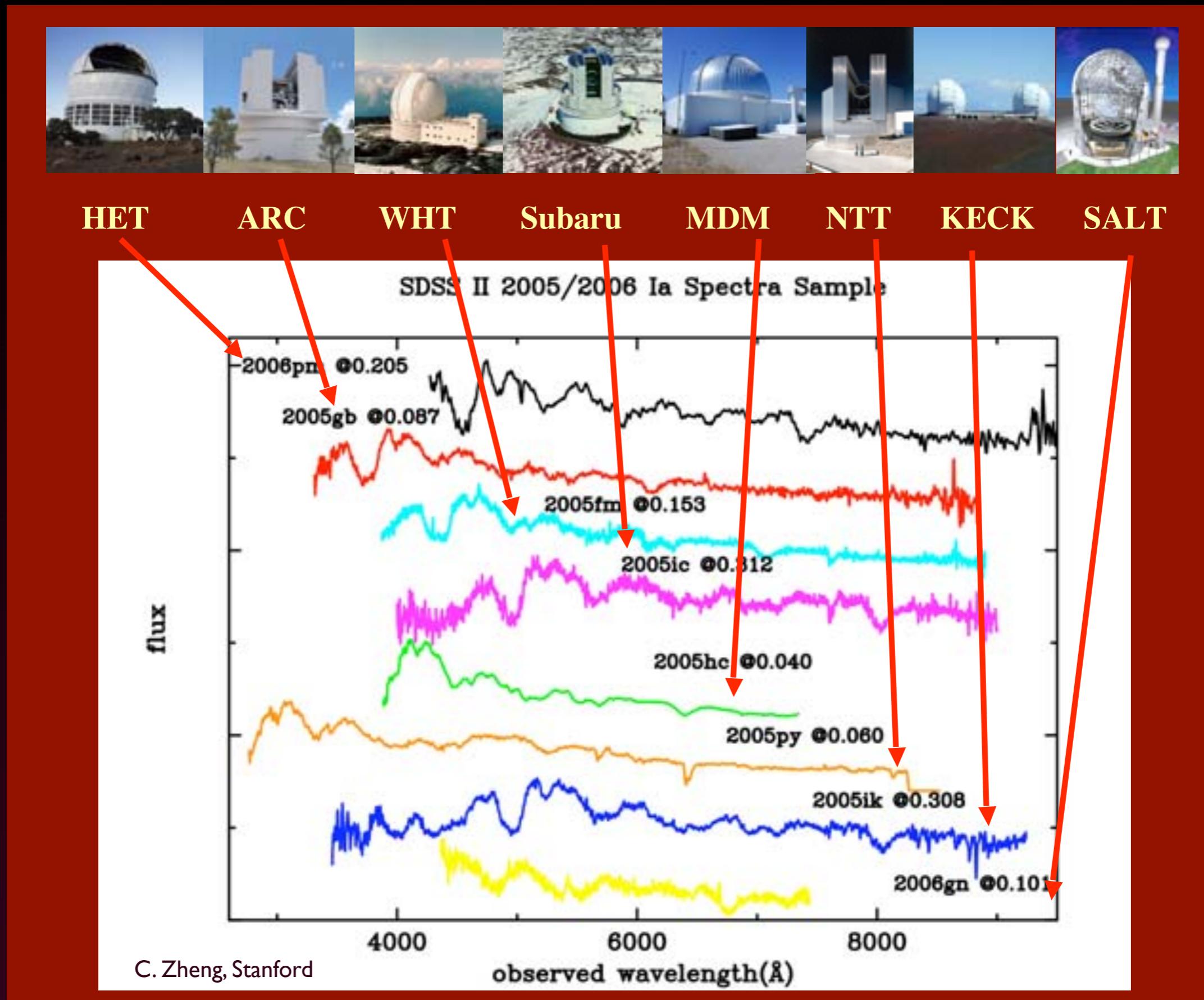
Fit type	Best	Criterion A	Criterion B
z fit	la	la	la
z constrained	la	la	la

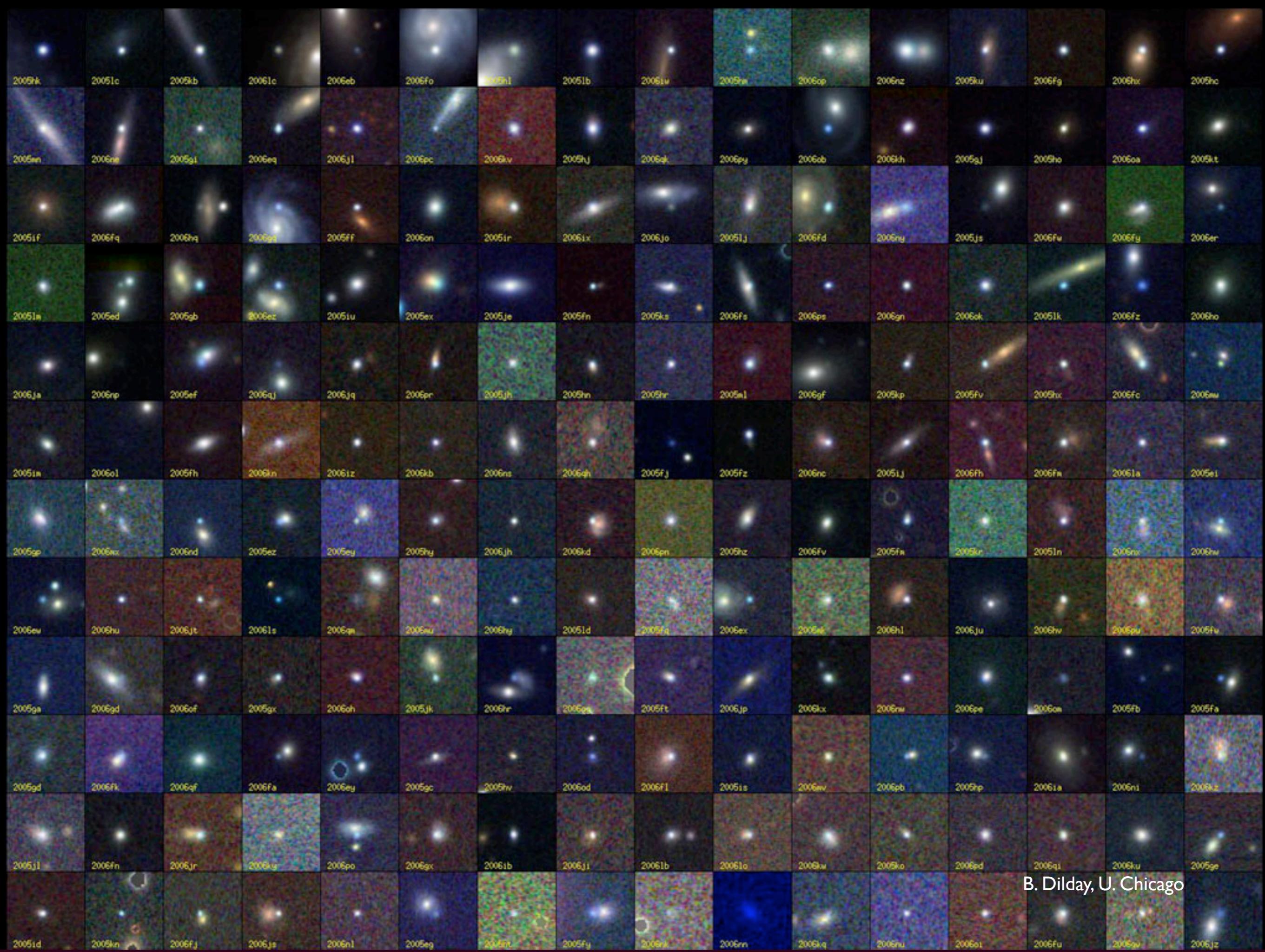


SN 2006fz
SN Ia $z = 0.105$

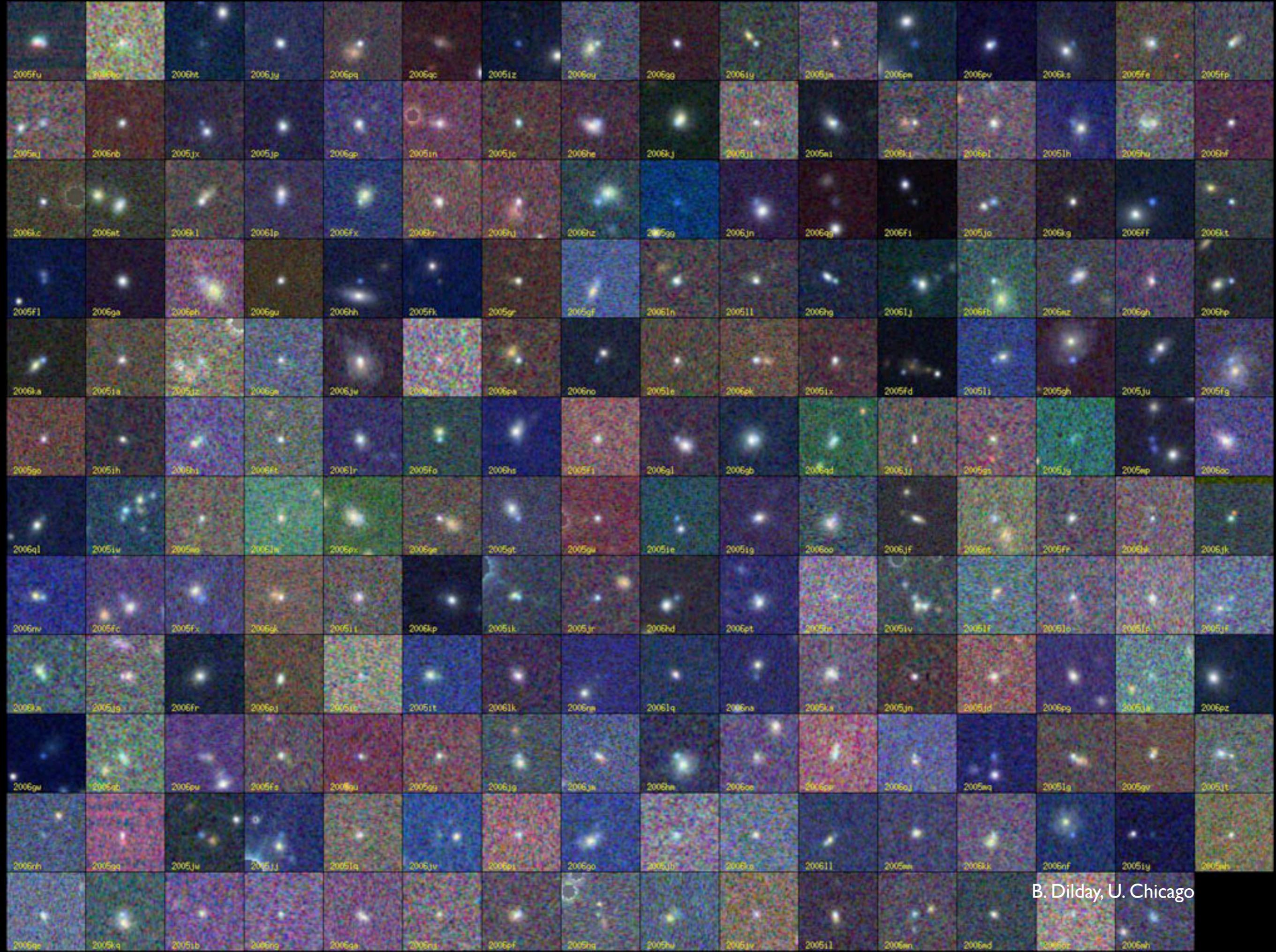
Bassett et al. (2007), CBET 627
continual web page updates
follow-up is encouraged!

SDSS SN Spectroscopy

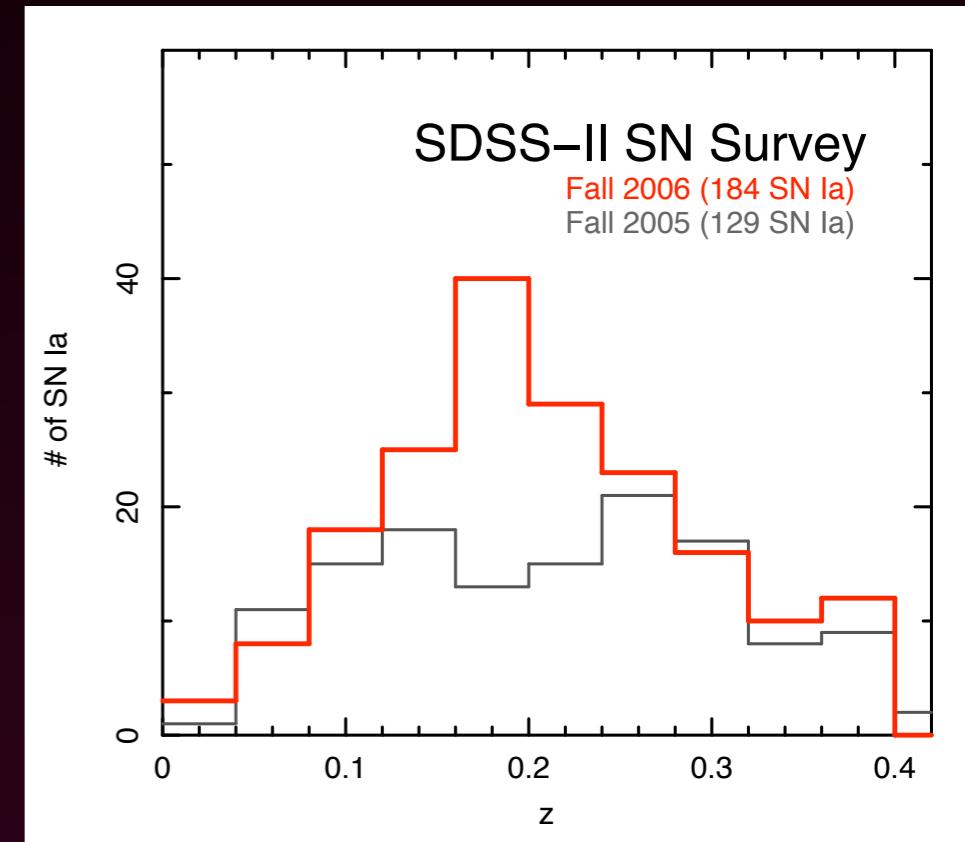
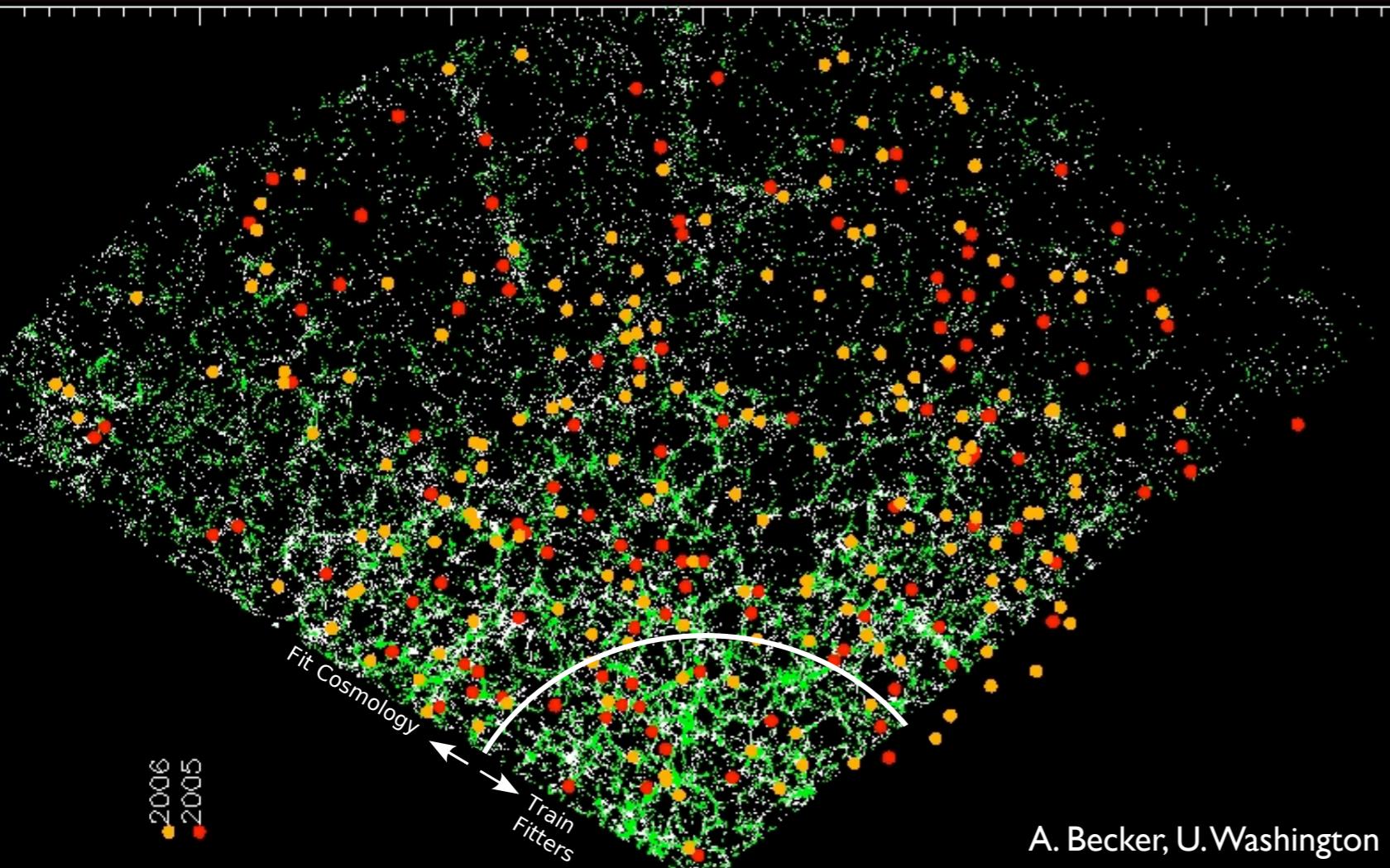
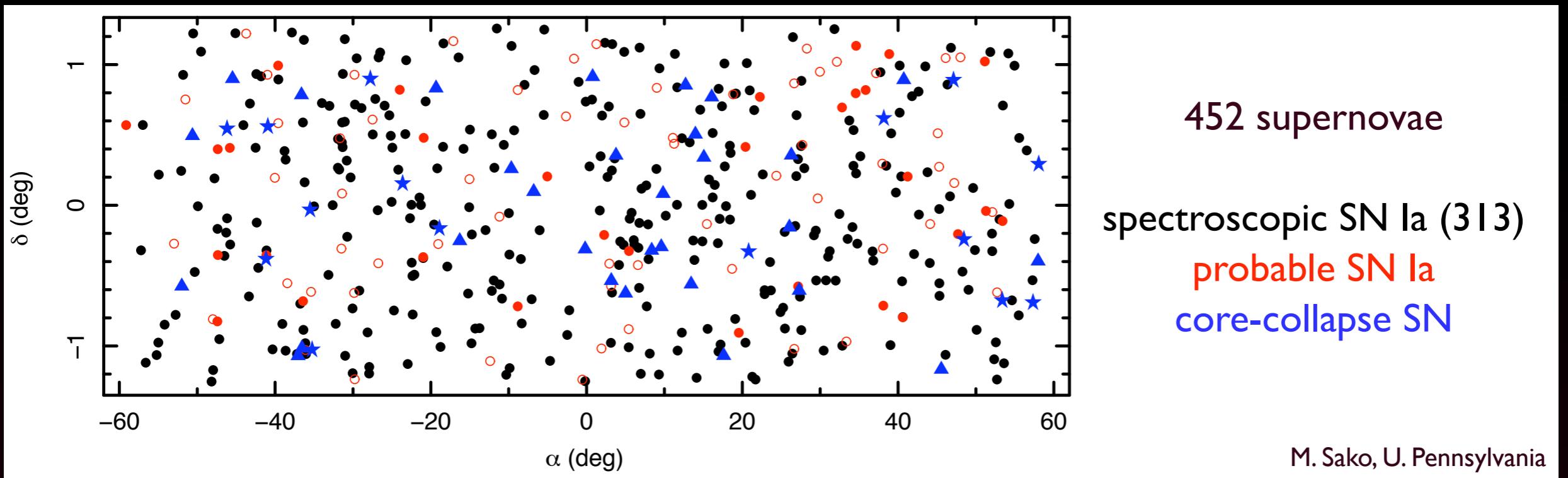




B. Dilday, U. Chicago



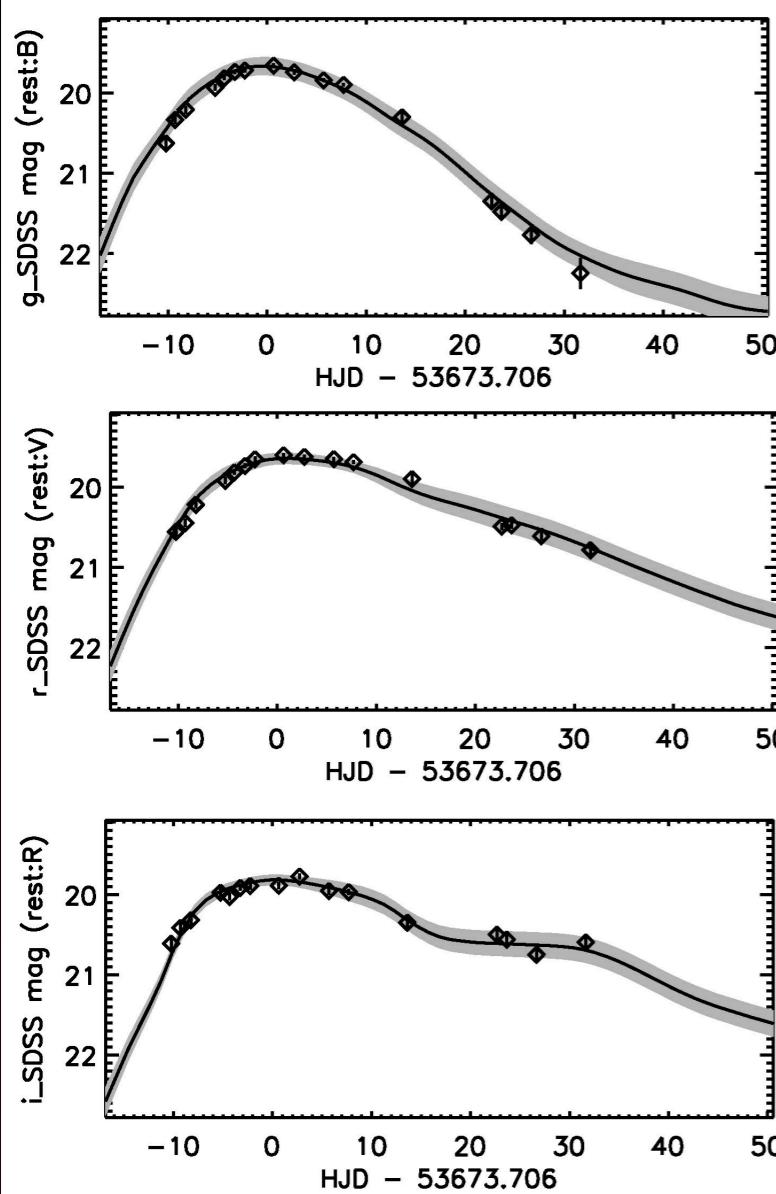
B. Dilday, U. Chicago



MLCS2k2 light-curve fits

Jha, Riess, & Kirshner
(2007, ApJ, in press)

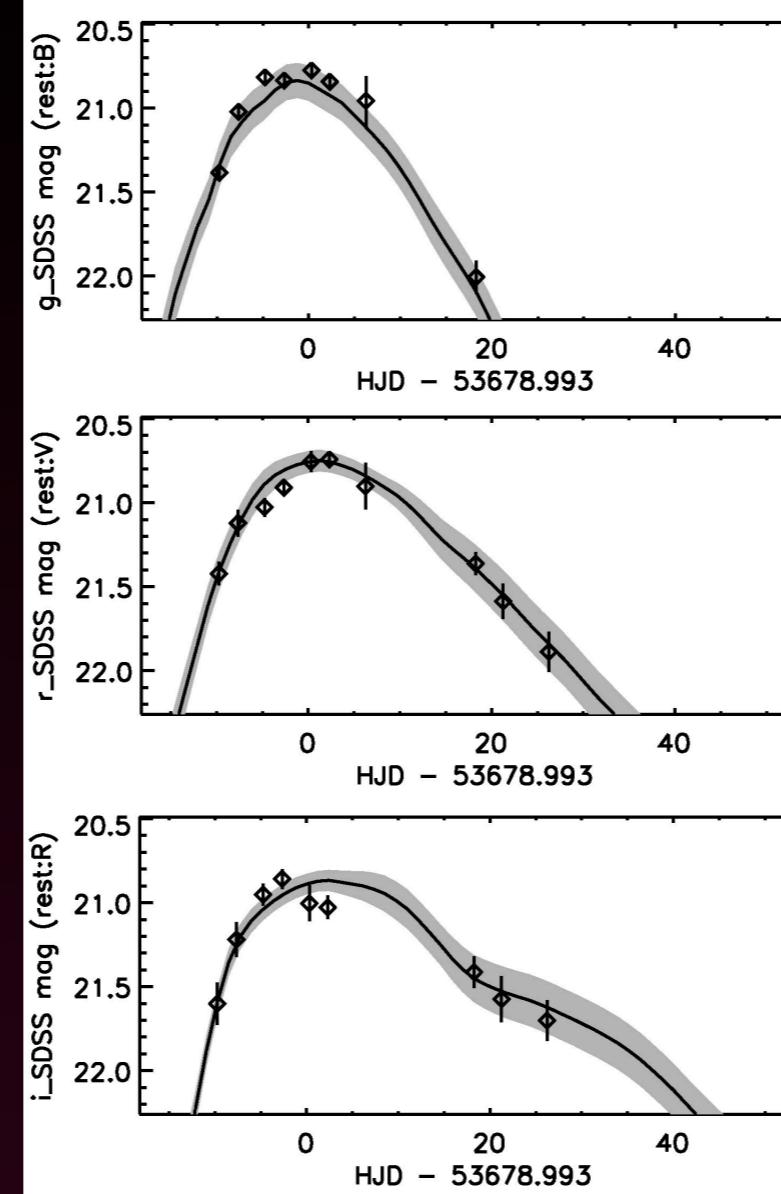
SN 2005ij $z = 0.124$



sn06406_SMP01_gri

$$\begin{aligned} t_0 &= 53673.706 \quad R_V = 3.10 \\ \Delta &= -0.14 \quad A_V = 0.20 \\ \mu_0 + 5 \log (H_0/65) &= 39.12 \\ E(B-V)_{MW} &= 0.08 \quad z = 0.1240 \\ \chi^2/\nu &= 21.32/44 \end{aligned}$$

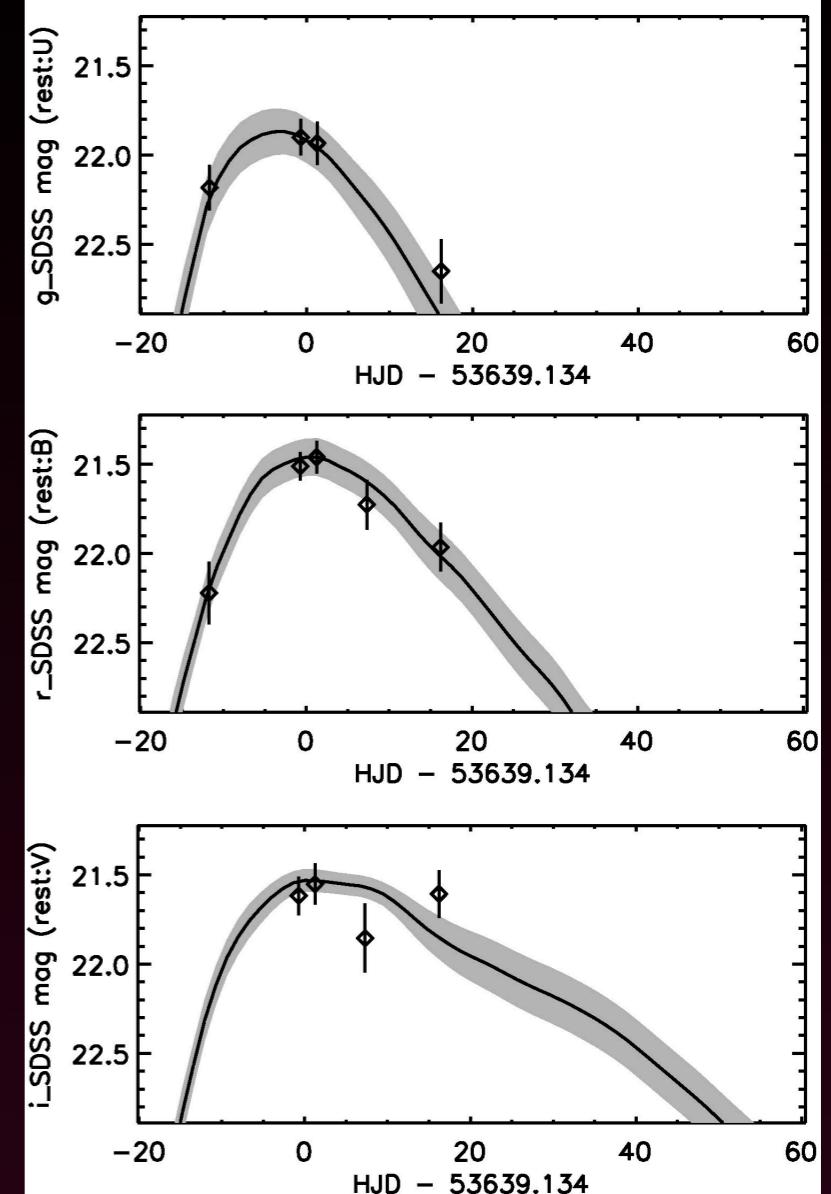
SN 2005ji $z = 0.214$



sn07473_SMP01_gri

$$\begin{aligned} t_0 &= 53678.993 \quad R_V = 3.10 \\ \Delta &= -0.02 \quad A_V = 0.09 \\ \mu_0 + 5 \log (H_0/65) &= 40.50 \\ E(B-V)_{MW} &= 0.02 \quad z = 0.2140 \\ \chi^2/\nu &= 15.52/23 \end{aligned}$$

SN 2005fs $z = 0.344$

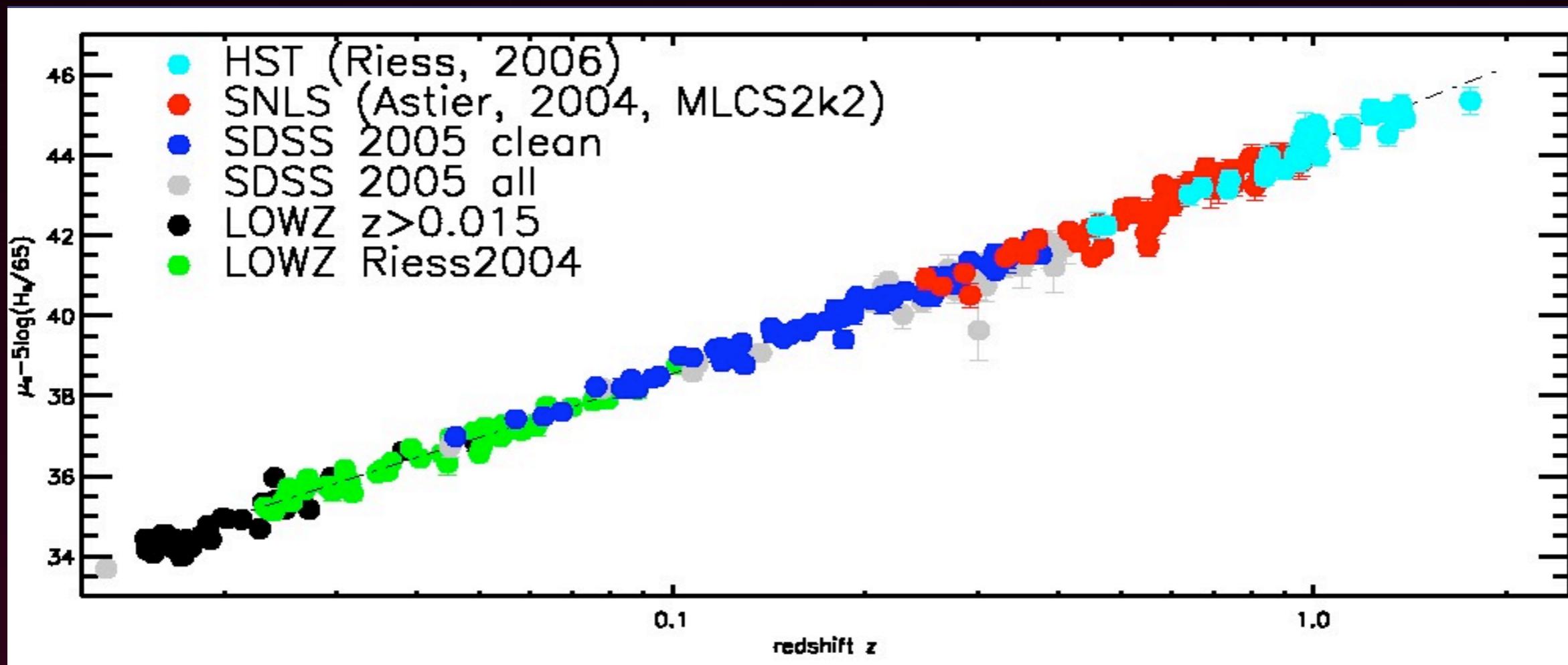
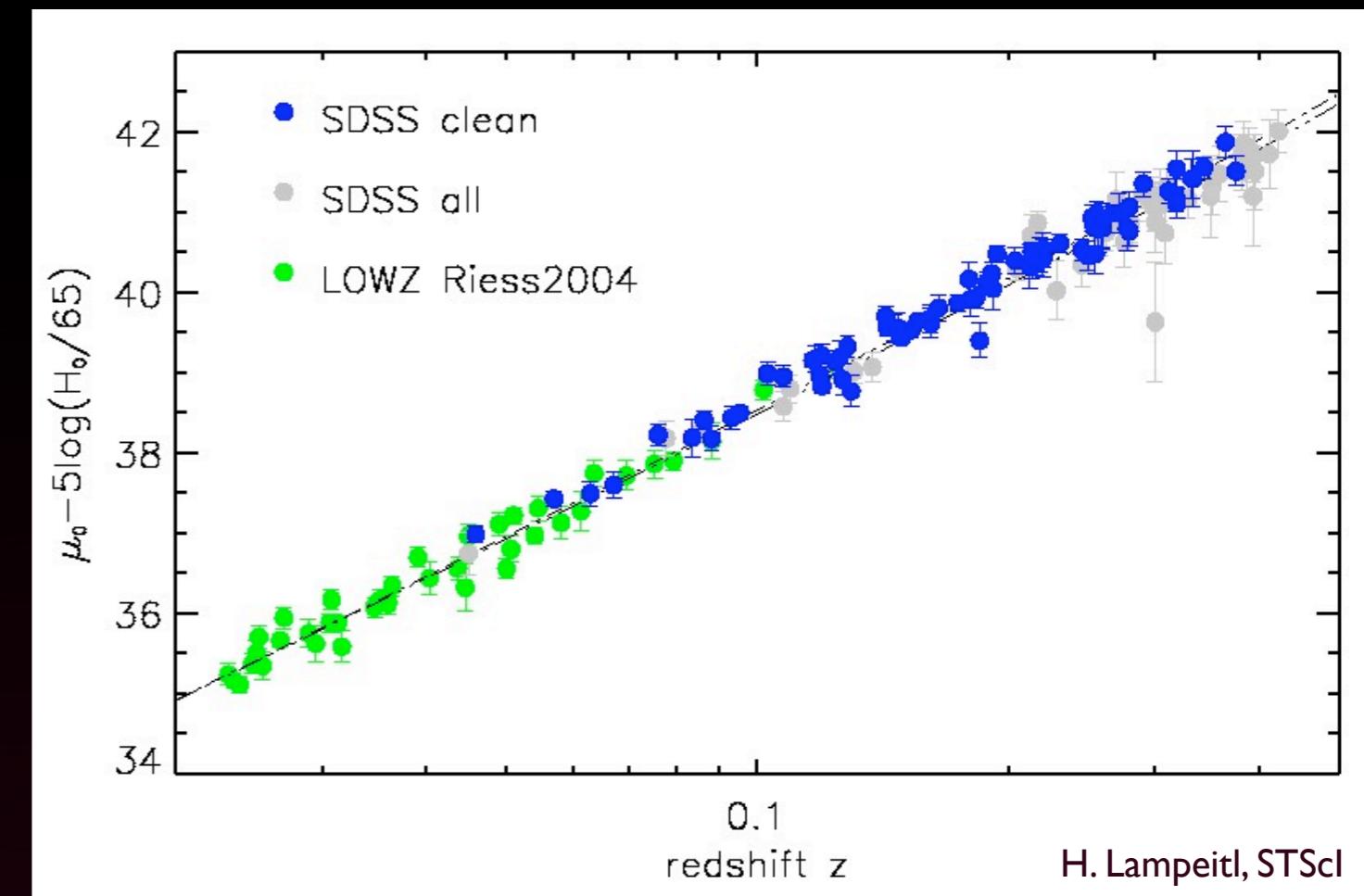


sn02533_SMP01_gri

$$\begin{aligned} t_0 &= 53639.134 \quad R_V = 3.10 \\ \Delta &= -0.32 \quad A_V = 0.10 \\ \mu_0 + 5 \log (H_0/65) &= 41.56 \\ E(B-V)_{MW} &= 0.03 \quad z = 0.3440 \\ \chi^2/\nu &= 5.86/9 \end{aligned}$$

SDSS SN Hubble diagram
from fall 2005 data
(129 SN Ia in all, 74 “clean”)

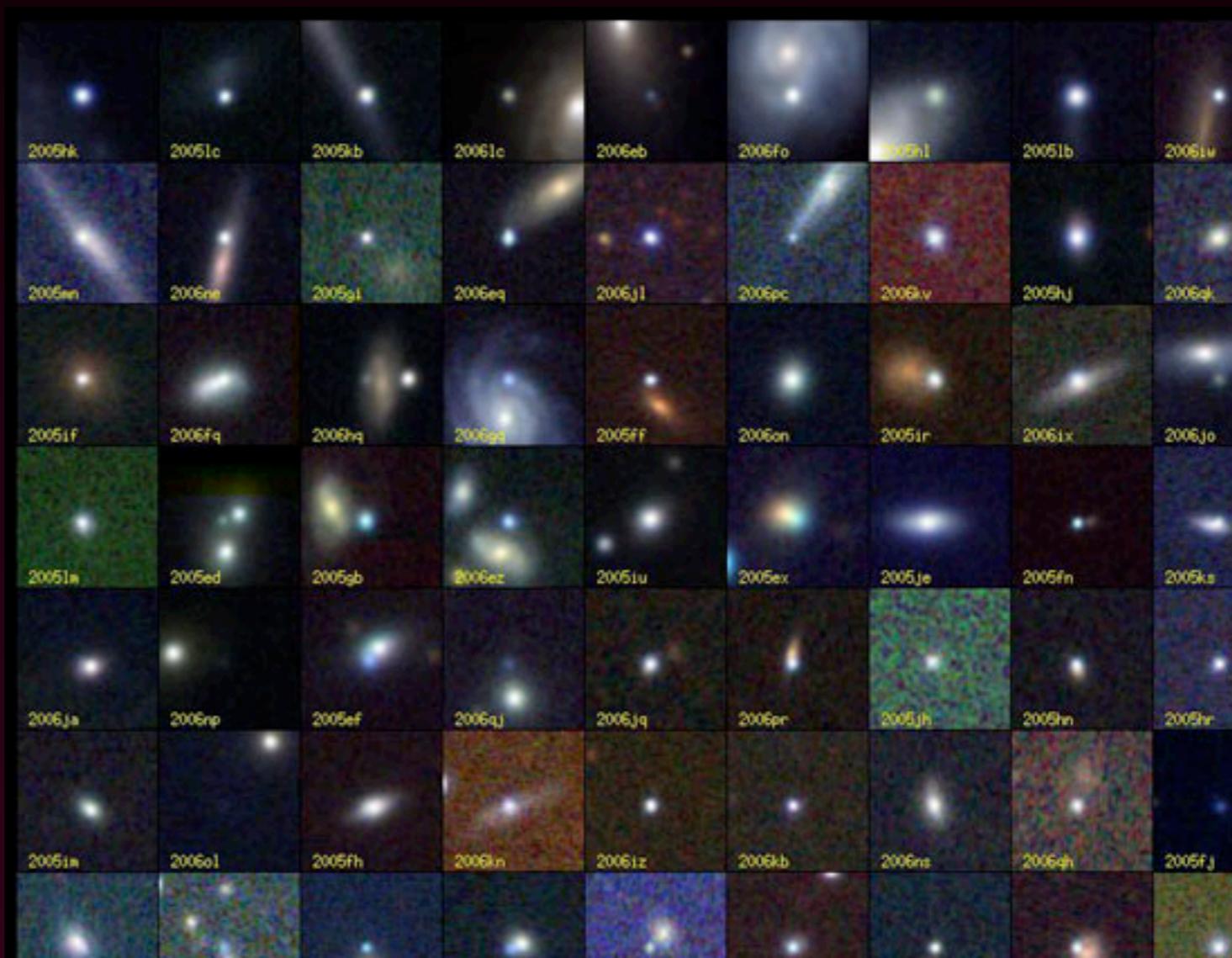
for the first time we have a
continuous expansion history
measured from SN to $z > 1$



“Peculiar” SN Ia: SN 2005hk

with SDSS-II,

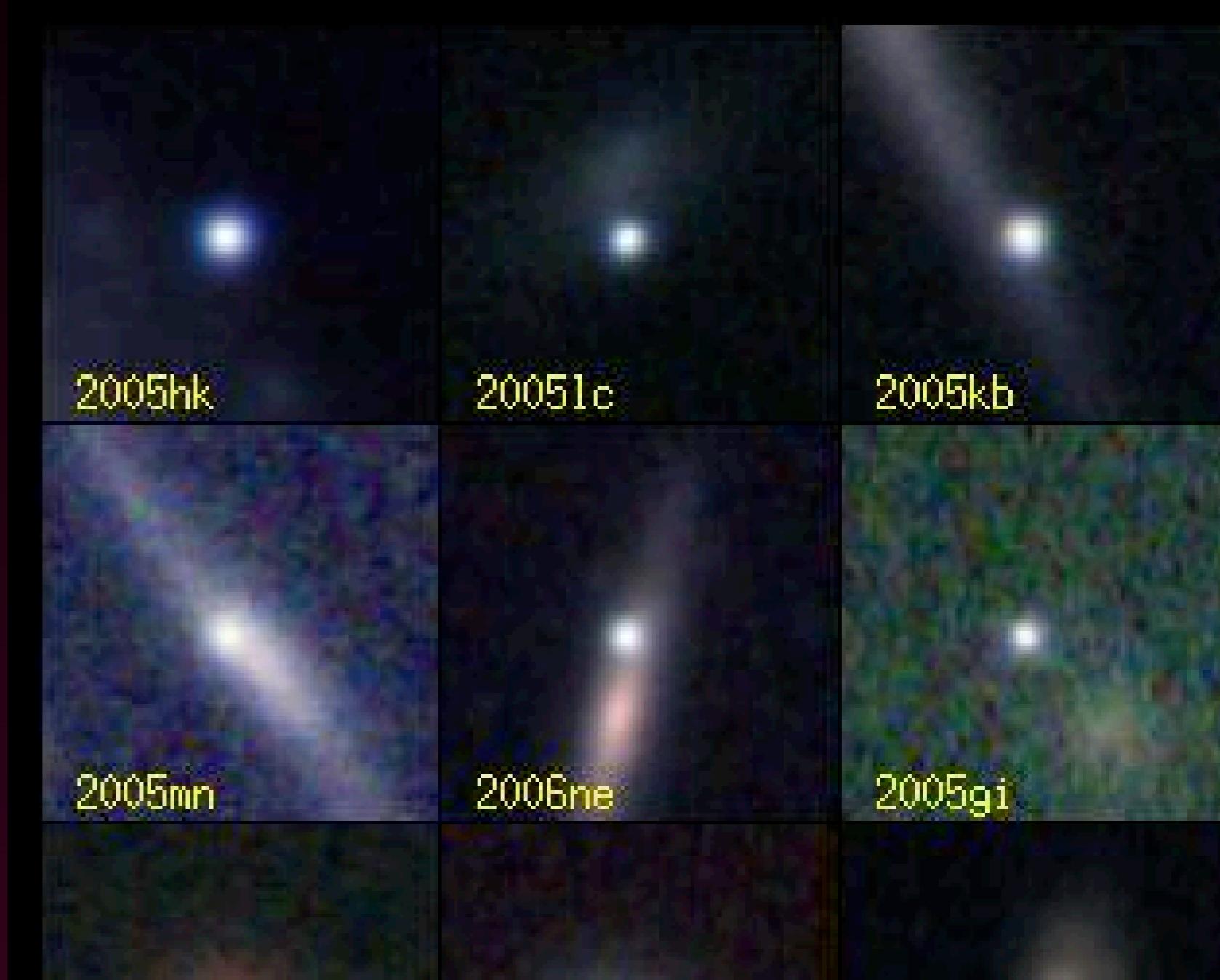
A. Filippenko, R. Chornock, R. Foley, W. Li (UC Berkeley),
D. Branch (U. Oklahoma), and M. Phillips (LCO)



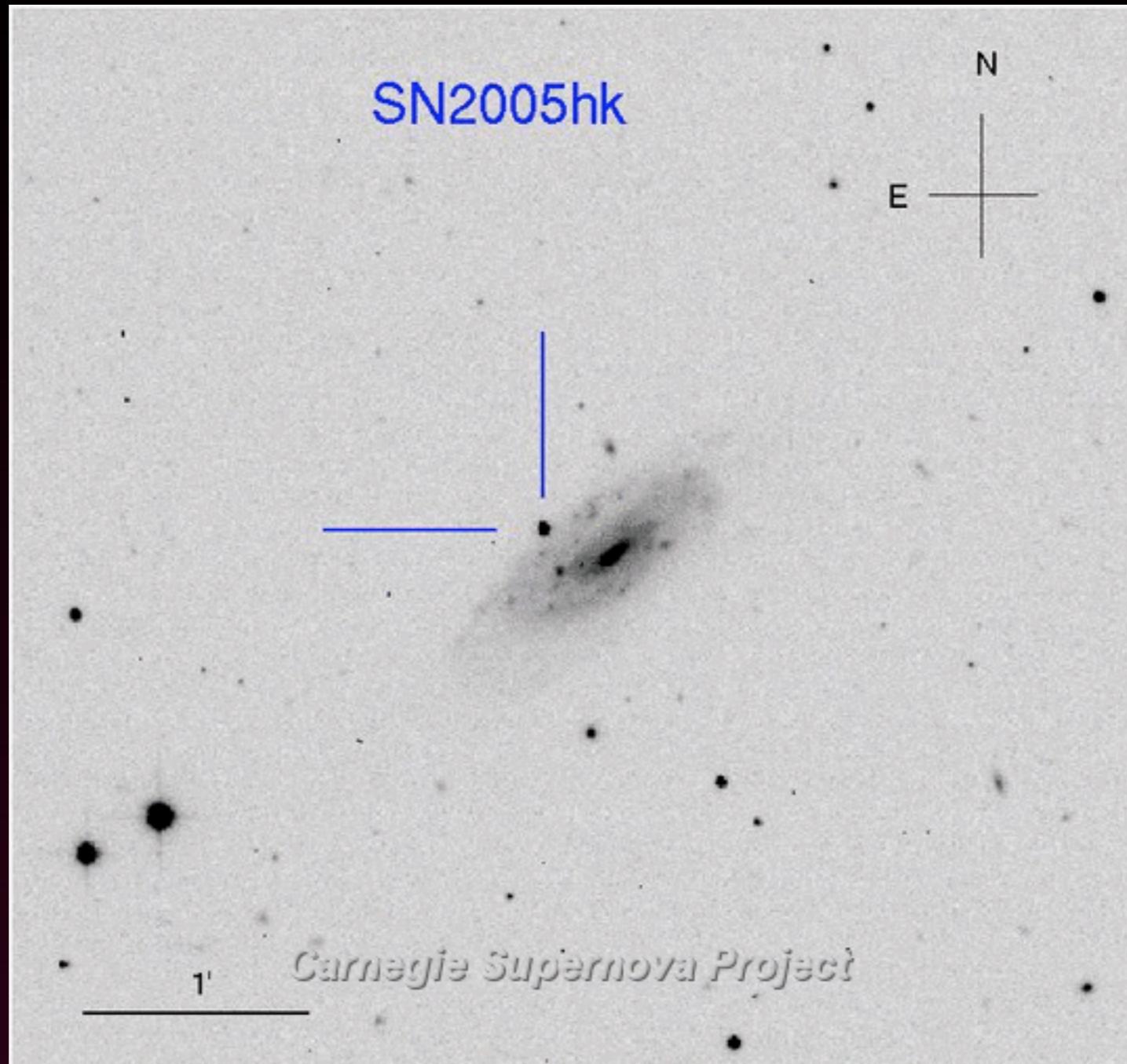
“Peculiar” SN Ia: SN 2005hk

with SDSS-II,

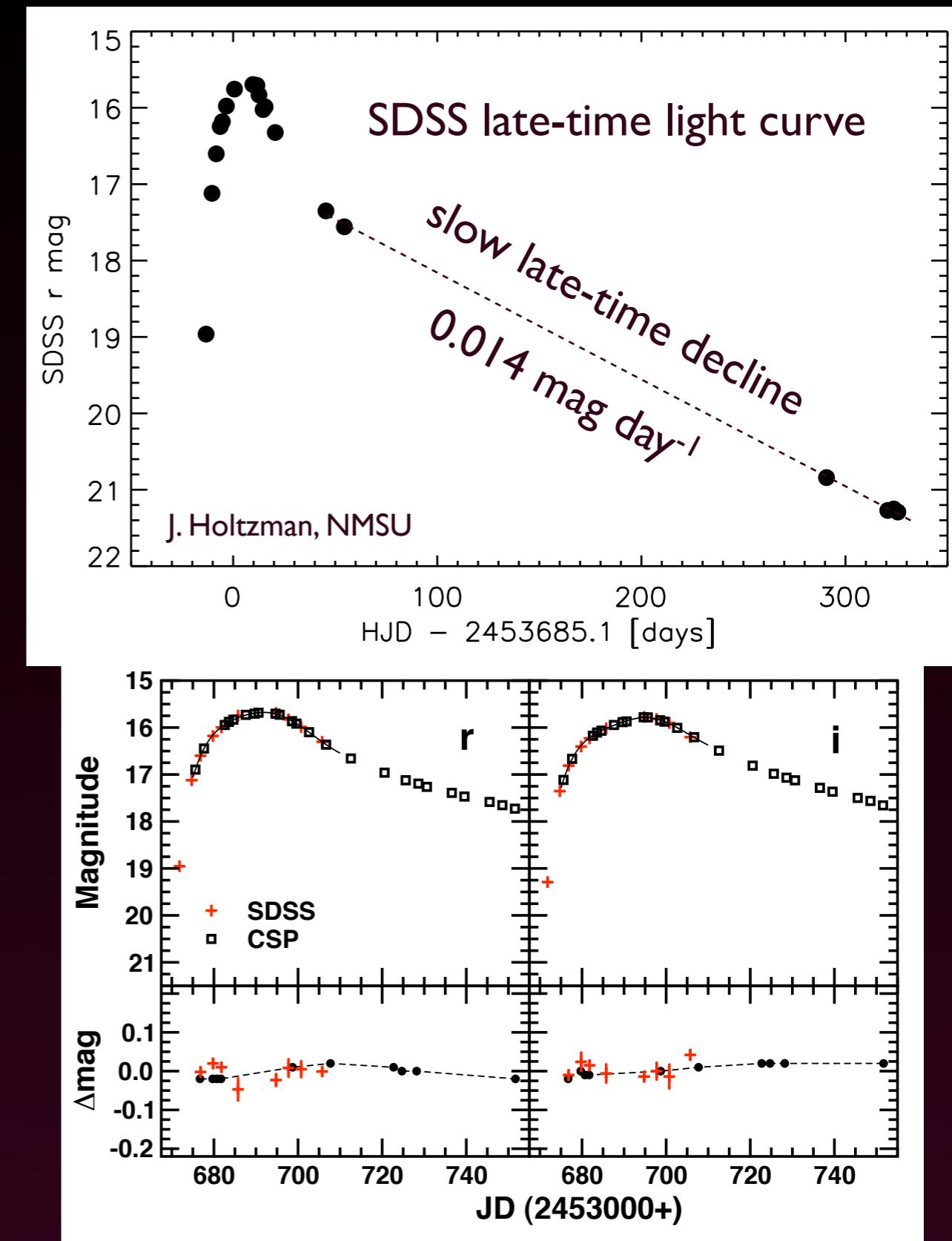
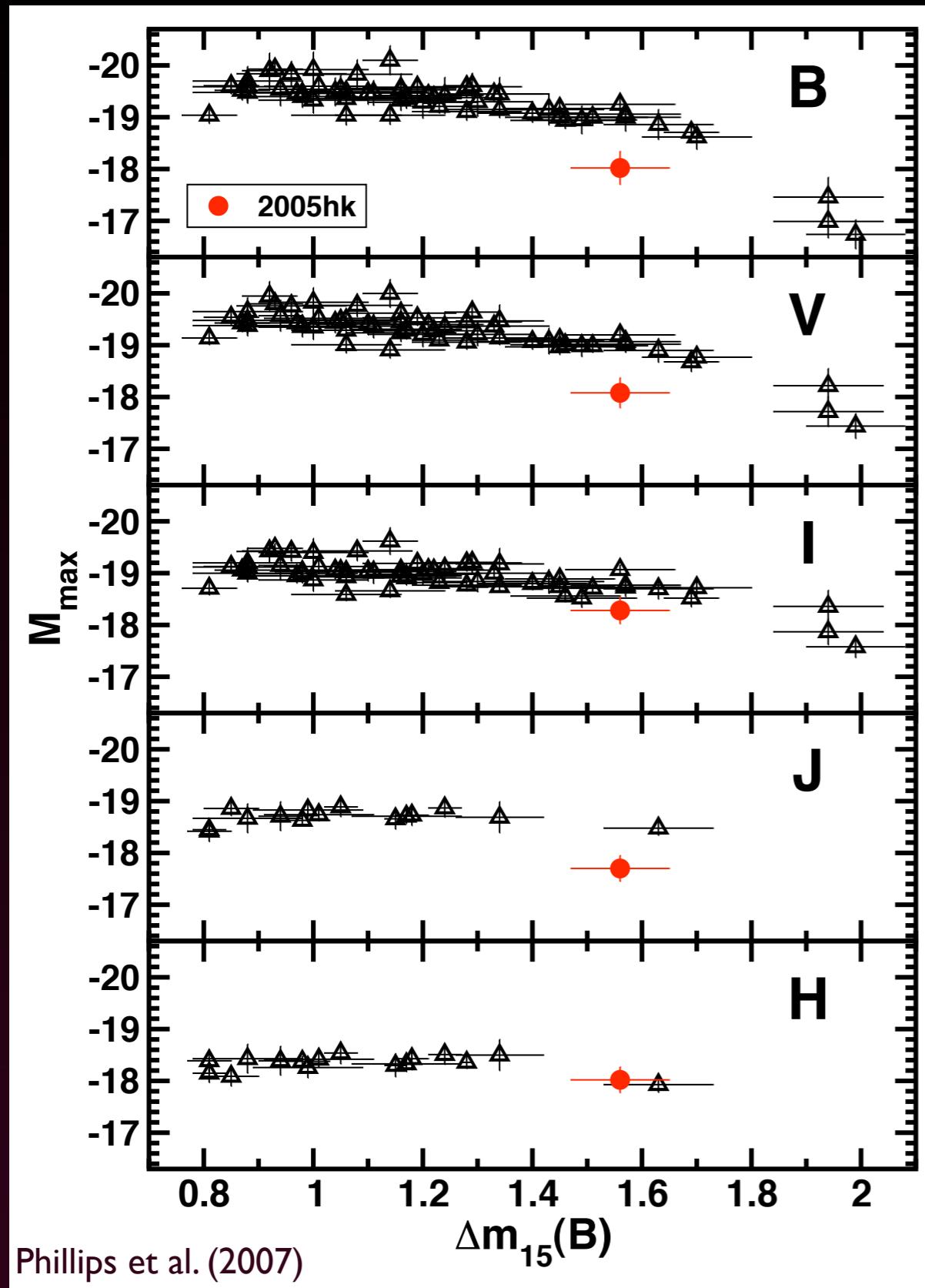
A. Filippenko, R. Chornock, R. Foley, W. Li (UC Berkeley),
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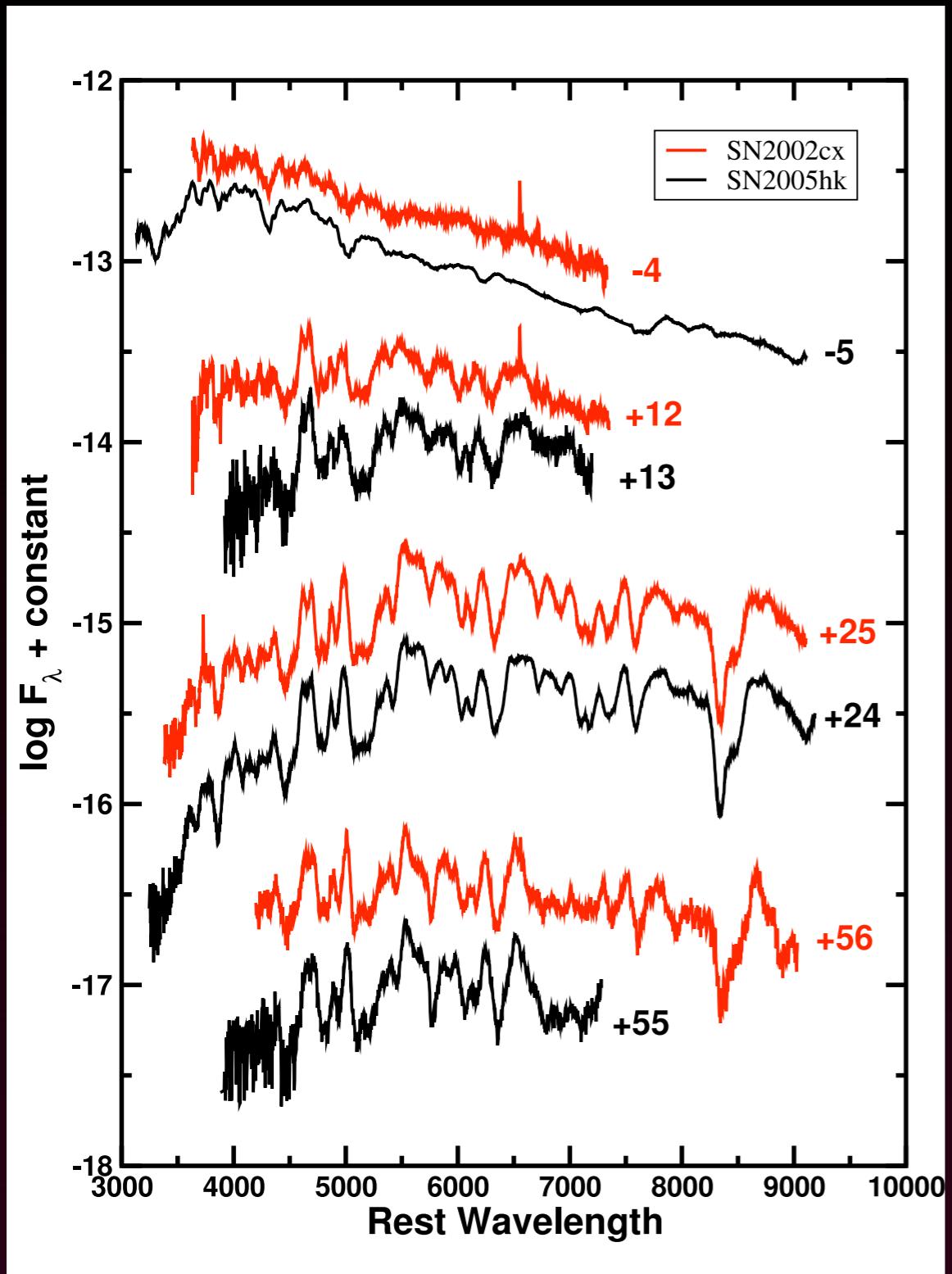
“Peculiar” SN Ia: SN 2005hk



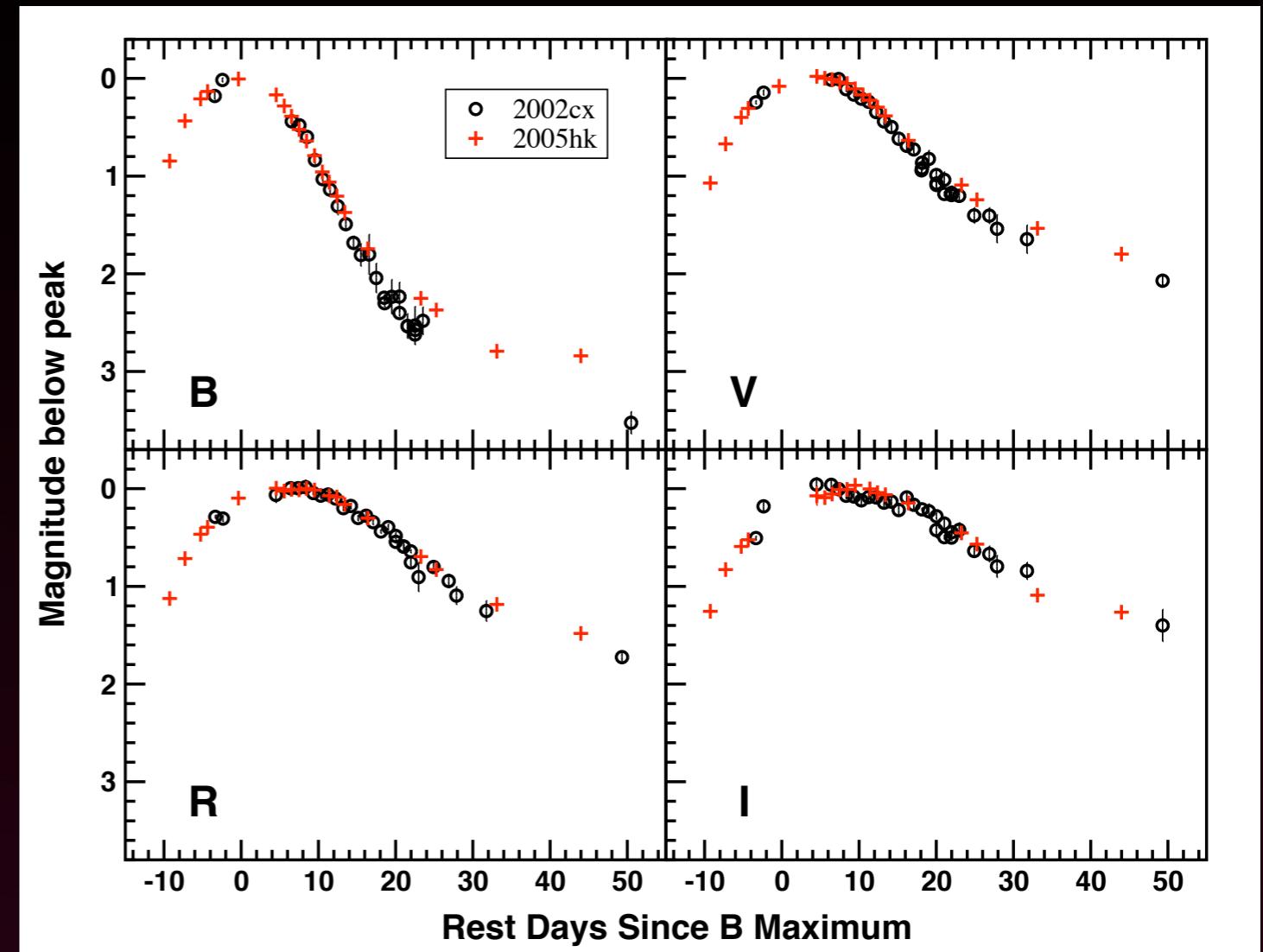
Fodder for Modelers: Peculiar SDSS SN



SN 2005hk: very similar to SN 2002cx

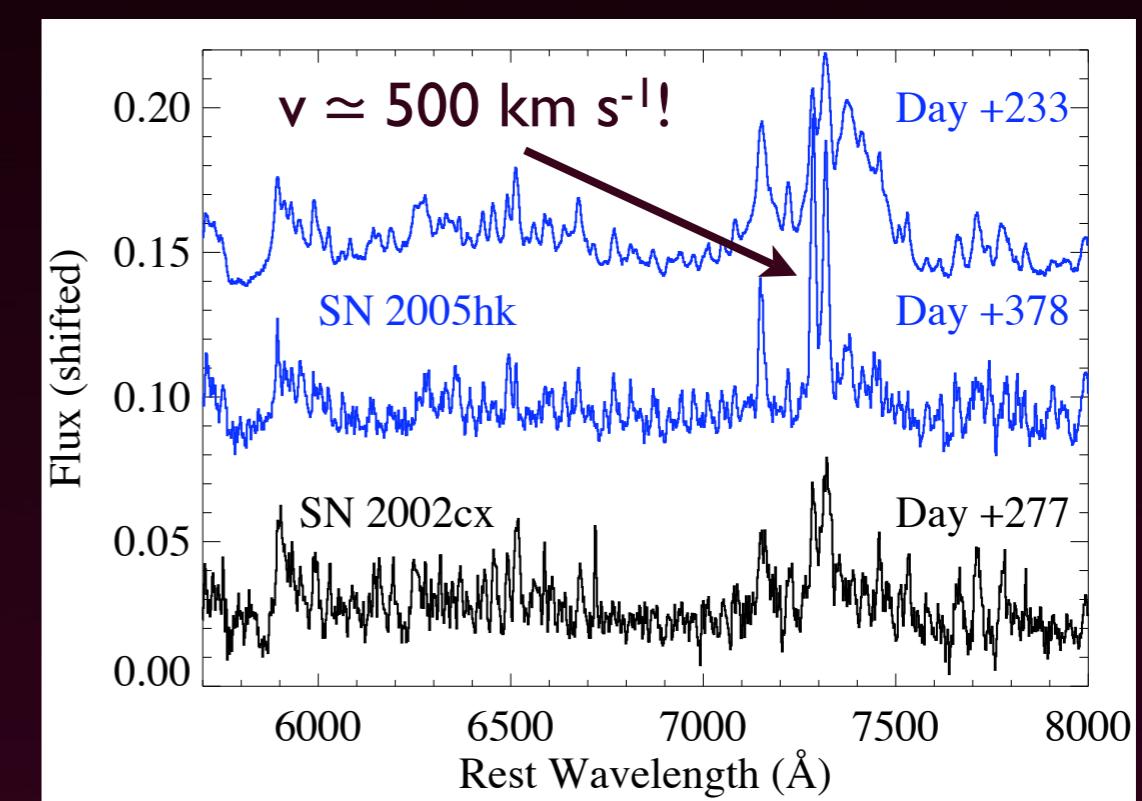
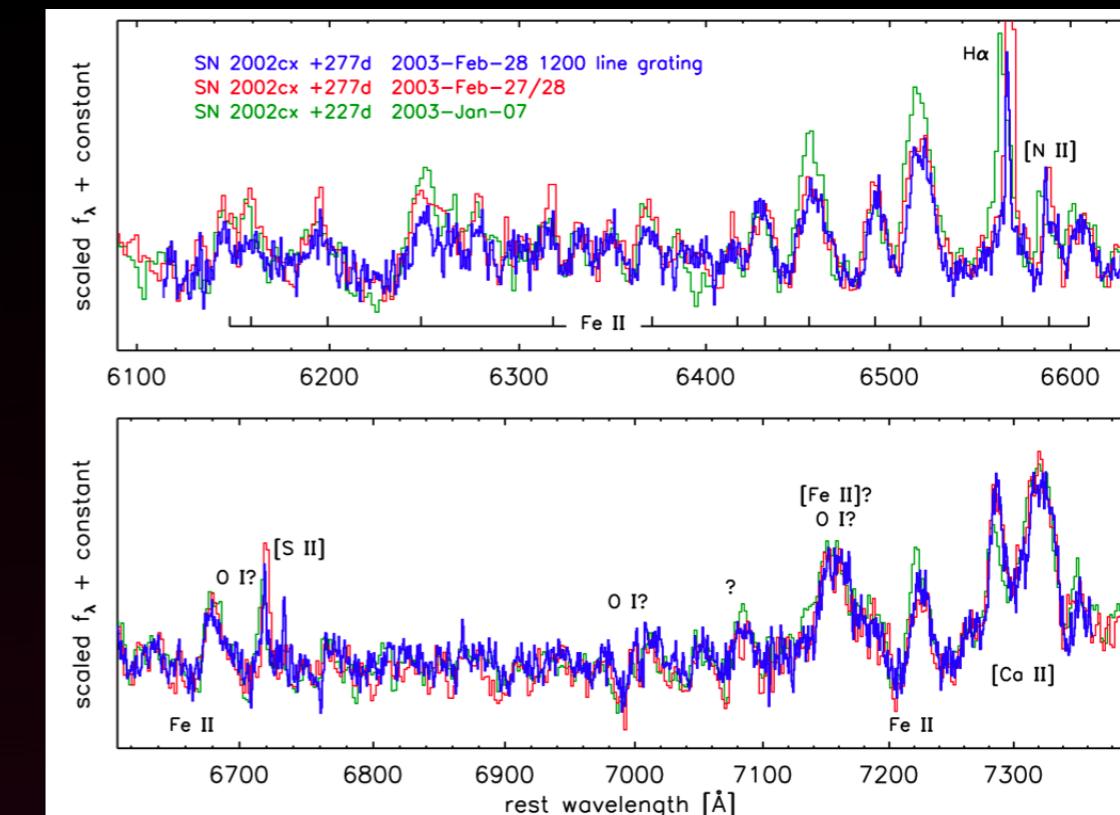
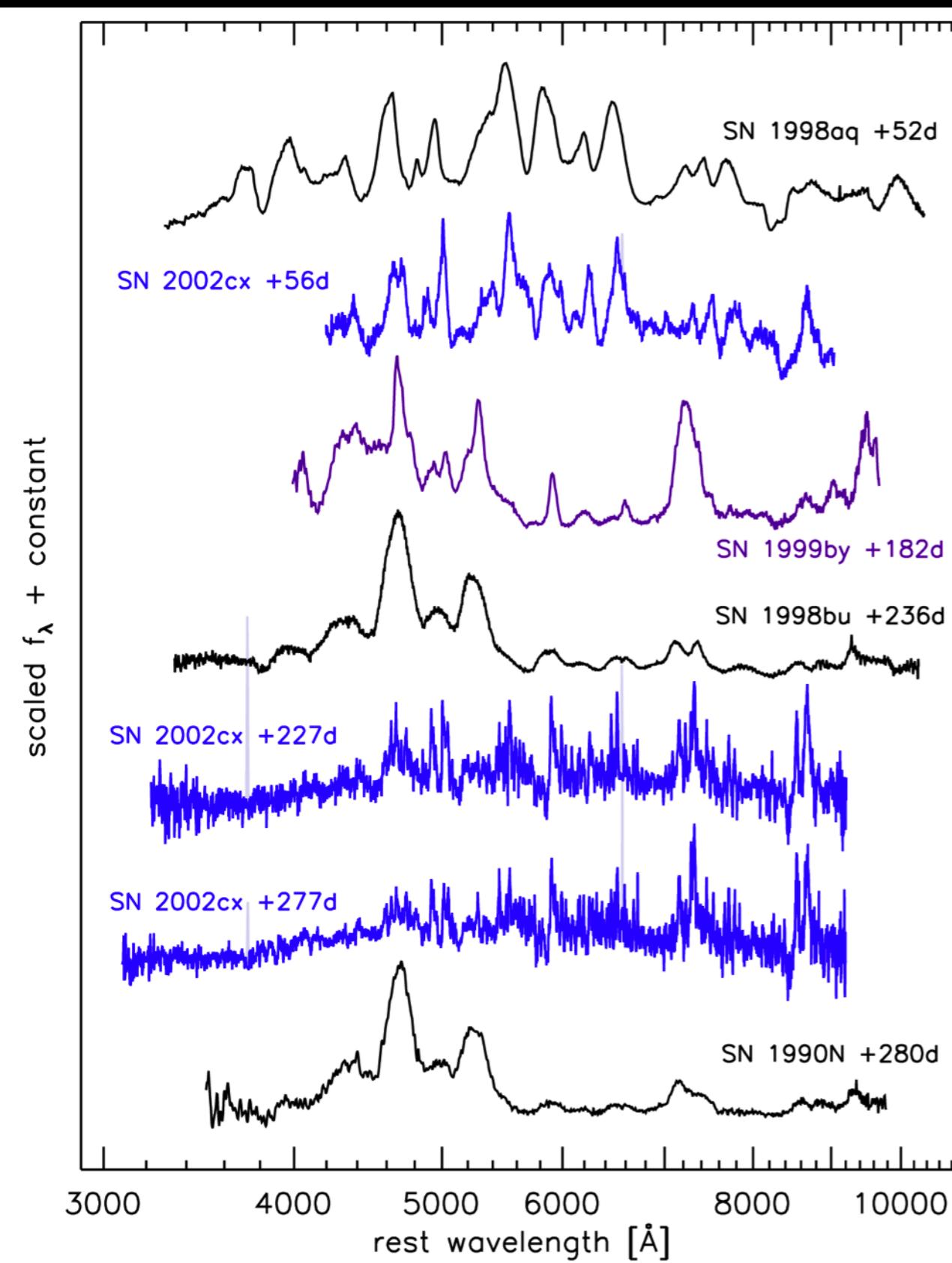


Li et al. (2003); Phillips et al. (2007)



very low velocities ($\frac{1}{2}$ normal at max)
subluminous for its decline rate
slow late-time decline
... and they don't become nebular!

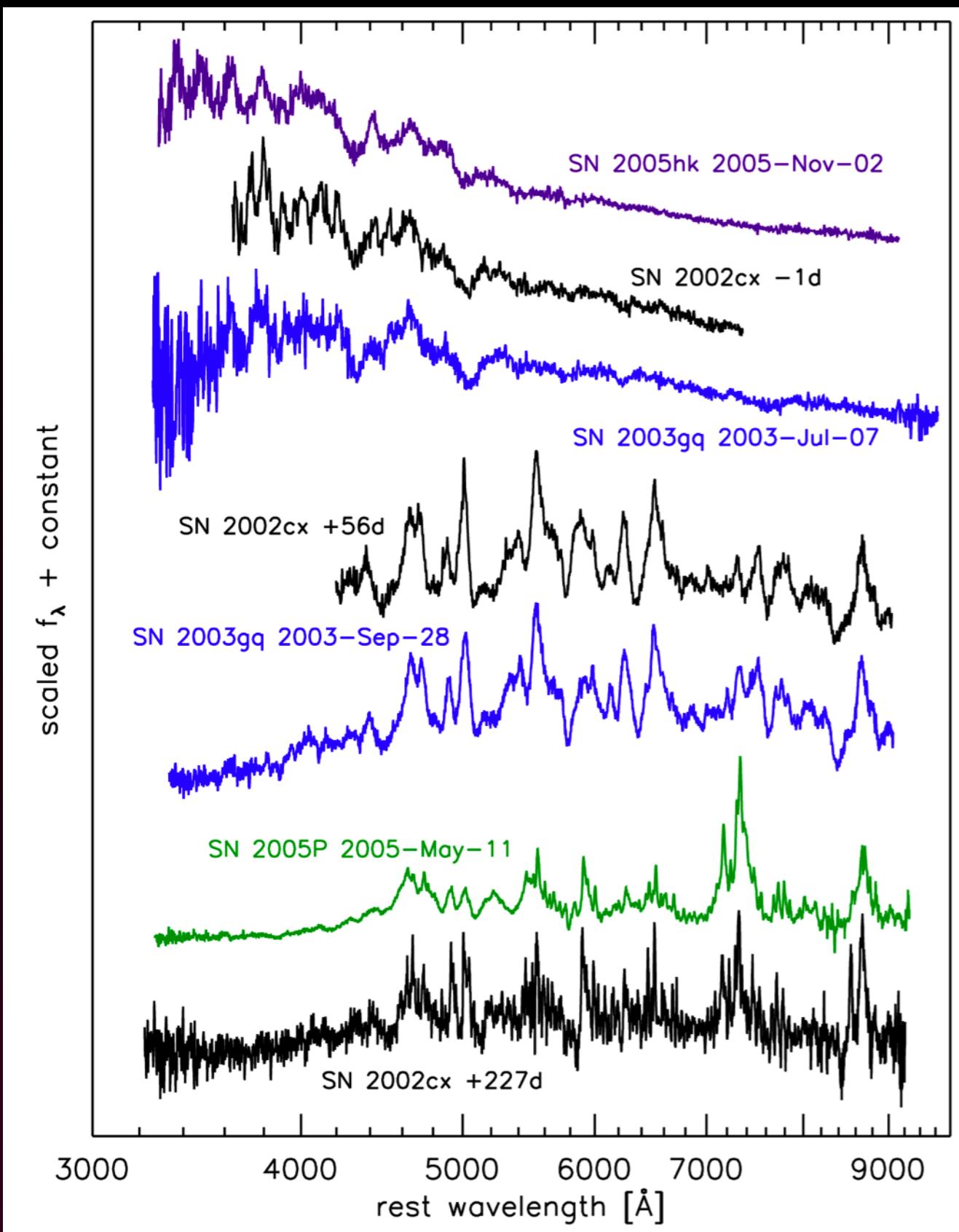
SN 2002cx and 2005hk Late-Time Spectra



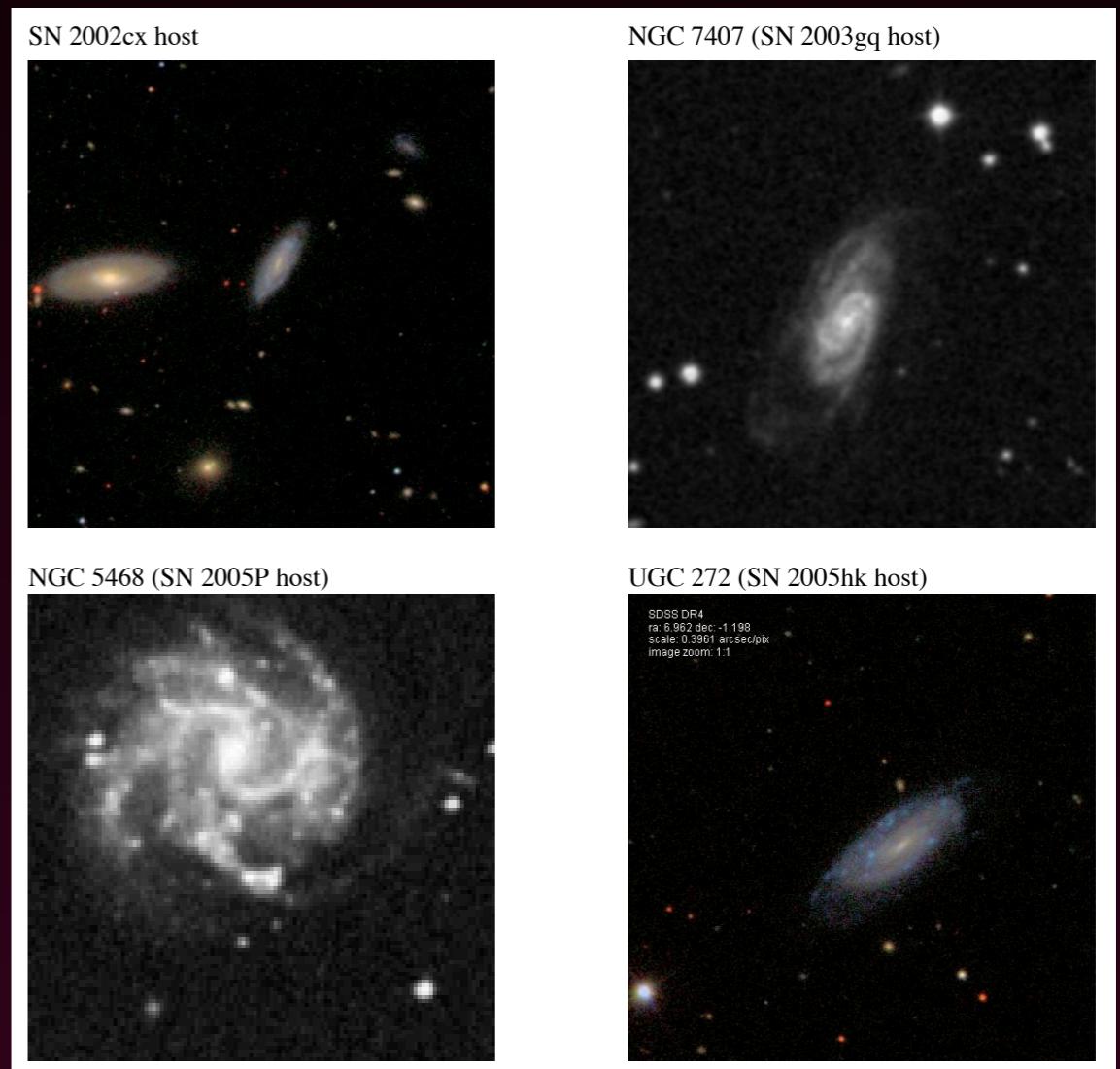
Li et al. (2003); Branch et al. (2004); Jha et al. (2006)

Chornock, Foley, & Filippenko (2006)

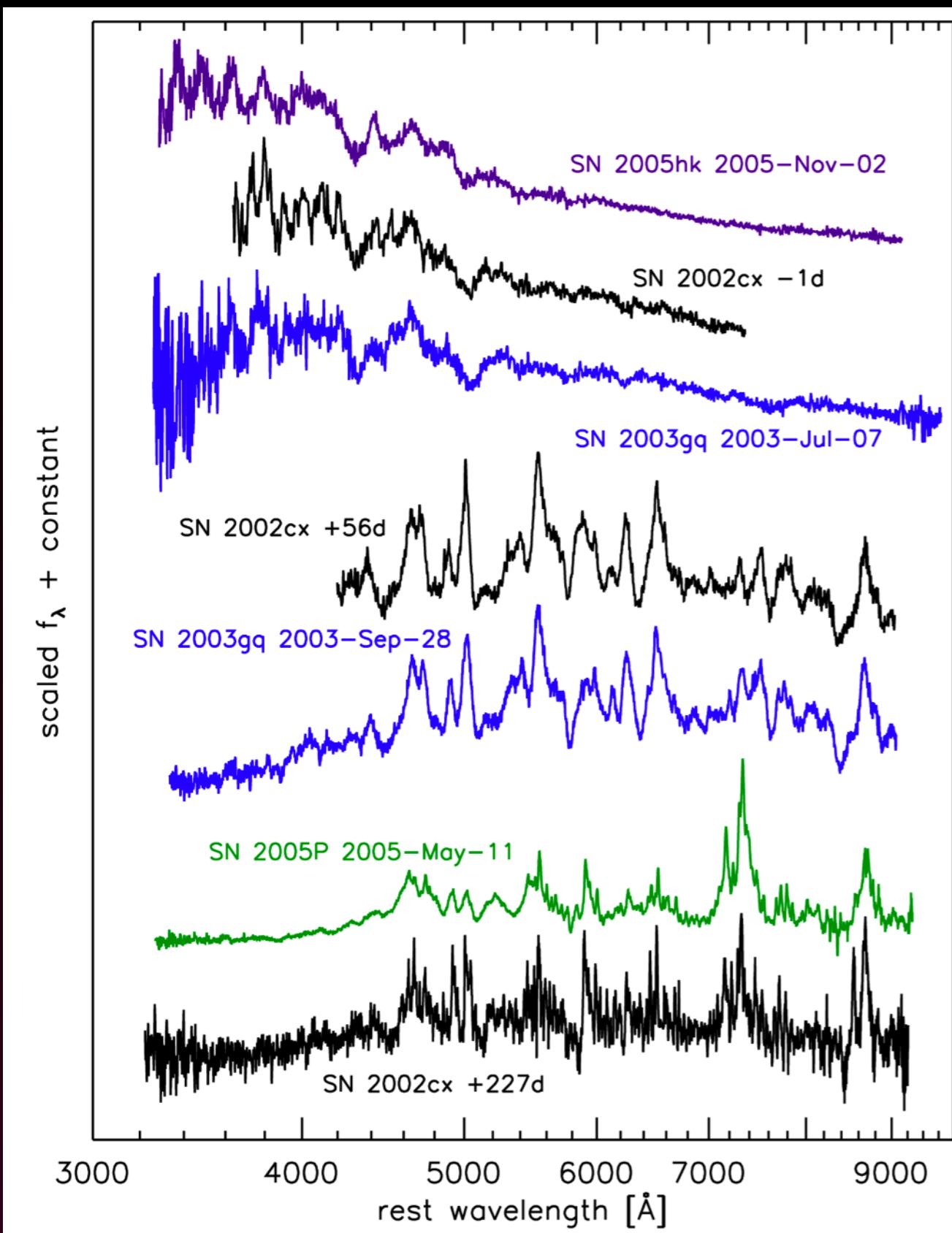
The SN 2002cx-like Subclass



- SN 2002cx, 2005hk, 2003gq, 2005P, 2005cc, 199Ibj (Stanishev 2006)
- Like normal SN Ia, 2005hk has low polarization (Chornock et al. 2006)
- very low velocities and luminosities
- all in blue, late-type hosts



The SN 2002cx-like Subclass



Jha et al. (2006)

- SN 2002cx, 2005hk, 2003gq, 2005P, 2005cc, 199Ibj (Stanishev 2006)
- Like normal SN Ia, 2005hk has low polarization (Chornock et al. 2006)
- very low velocities and luminosities
- all in blue, late-type hosts
- cosmological implications?
- progenitor models:
 - mixed layers, low ^{56}Ni mass
 - low-velocity unburned material
 - weak 3-d deflagration?
 - high mass and density at low velocity: “failed” SN Ia?
- peculiar objects may be the key to understanding normal SN Ia!

